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The Validity of Circulatory-Respiratory Measures As An Index of Endurance Condition in Swimming

By J. H. McCurdy, M.D.
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THIS study shows definite trends in correlation, utilizing varsity and Olympic swimmers, between organic efficiency and actual performance in swimming the 440 yards. Top-notch men in performance show higher grades of organic efficiency. This work should be supplemented by case studies to determine the relationship of performance to changes in organic efficiency.

Since the publication of the McCurdy-Larson Organic Efficiency Test [1, 2] and the revision,[3] an experiment has been conducted on the further validity of circulatory-respiratory items. This study along with the one in progress on the naval flyers (328 men) shows the heart rate to be more variable and more largely influenced by external causes than any of the other items. This was also found in a study on civil air line pilots.[4]

The criteria used for the validation of the test items in the Organic Efficiency Test were the "good" physiological group represented by 60 Springfield College varsity swimmers in mid-season condition and 40 American Olympic swimmers in the peak of condition before the start of the Olympic games in Germany, and the "poor" physiological group represented by 138 infirmary patients examined immediately after confinement in the infirmary for two or more days with respiratory infections. These criteria were considered valid as it was found that there was a significant fluctuation in the test items between "good" and

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[1] J. H. McCurdy and L. A. Larson, "The Measurement of Organic Efficiency for the Prediction of Physical Condition," Suppl. to Res. Quart., 6:2 (May 1935) 11–41.

[2] J. H. McCurdy and L. A. Larson, "The Measurement of Organic Efficiency for the Prediction of Physical Condition in Convalescent Patients," Res. Quart., 6:4 (Dec. 1935) 78–97.

[3] J. H. McCurdy and L. A. Larson, *The Physiology of Exercise* (Philadelphia: Lea and Febiger, 1939) 315–336.

[4] R. A. McFarland, A. Graybiel, Eric Liliencrantz, and A. D. Tuttle, "An Analysis of the Physical and Psychological Characteristics of 200 Civil Air Line Pilots," *Journal of Aviation Medicine* (Dec. 1939) 160–210.

"poor" condition.[5] Comparing the "good" health and the poor health scores of the 73 men in this experiment, significant changes were found in the sitting diastolic pressure, breath-holding 20 seconds after exercise, and standing pulse pressure. In the poor group, as compared to the good group, the sitting diastolic pressure was higher, the breath-holding lower, and the standing pulse pressure lower. These changes were found to be significant after the development of the Organic Efficiency Test and the scoring of the men in the test (r_{bis}=.6454).

Improvement was shown with training (rise in the Organic Efficiency Index score) for swimming.[6] This change was not large because the experimental group used was in good condition before training for swimming. Wide physiological changes could not be expected (r_{bis}=.2810: Organic Efficiency Test with *before* and *after* training).

These physiological facts seem to justify the criteria used for the validation of the Organic Efficiency Test. However, it was with the idea of gaining further validity of these physiological measures that this experiment was undertaken. A significant differentiation was found between the good and the poor group criteria using the Organic Efficiency Test (r_{bis}=.7033); the question is, however, is the test significant in indicating variations in physiological efficiency within each group? Specifically, the experiment was conducted using the "time" for the 440-yard swim as the criterion of swimming endurance and using only skilled swimmers in this distance. This group is the same group as the good group criterion used in the development of the Organic Efficiency Test.

SIGNIFICANCE OF PROBLEM

The contribution of this research is in further validity of circulatory-respiratory measures. If it can be demonstrated that not only can these measures significantly differentiate between physiologically good and poor groups, but they can also rank the variations of functional efficiency within the good group, it will add greatly to the validity.

Endurance swimming calls for real conditioning of the circulatory-respiratory systems. Coaches are interested in knowing the "present" physiological fitness of their men. They are interested from the standpoint of best possible *time* as well as from the standpoint of whether participation is physiologically safe.

PROCEDURE

Source of Data.—The data for this research were collected at Springfield College and at Yale University.[7] At Springfield College, 60 of the

[5] L. A. Larson, "A Study of the Validity of Some Cardiovascular Tests," New York University, Ph.D. Dissertation, Oct. 1938. Abstract published: *Journal of Experimental Education*, 7:3 (March 1939) 214–220.

[6] *Loc. cit.*

[7] The writers wish to express their appreciation to Coach R. J. H. Kiphuth of Yale University for his cooperation and encouragement of the experimental work on the Olympic swimmers.

most mechanically efficient swimmers were examined. At Yale University 40 candidates for the American Olympic swimming team were examined after having reached the peak of condition. The infirmary subjects were also examined at Springfield College; 138 subjects examined after recovering from respiratory infections.

Circulatory-Respiratory Test Items.—In order to determine in an introductory way those items having some possibility of validity of endurance condition in swimming, 46 circulatory-respiratory items were used in the examination of 20 mechanically efficient swimmers. The items were reduced by the criterion and intercorrelations. Only the significant ones were retained. The shorter battery of tests, which seemed to have some significance, were then given to 40 additional skilled swimmers, 40 Olympic swimmers, and 138 infirmary patients.

The reduced battery of tests is:

1. Horizontal pulse rate
2. Sitting pulse rate
3. Standing pulse rate
4. Horizontal systolic, diastolic, and pulse pressures
5. Sitting systolic, diastolic, and pulse pressures
6. Standing systolic, diastolic, and pulse pressures
7. Vital capacity, with body temperature correction
8. Breath-holding 20 seconds after exercise (standard exercise)
9. Pulse rate two minutes after the standard exercise.
10. Pulse rate after the 440-yard swim
11. Difference between hor.-std. pulse rates
12. Difference between hor.-std. systolic pressures
13. Difference between hor.-std. diastolic pressures
14. Difference between hor.-std. pulse pressures
15. Difference between nor. std. pulse rate and pulse rate two minutes after standard exercise and the breath-holding test
16. Difference between nor. std. pulse rate after the 440-yard swim
17. Barach Cardiovascular Test [8]
18. Stone Cardiovascular Test [9]
19. Tigerstedt Cardiovascular Test [10]
20. Pulse pressure $\times$ pulse-rate index
21. Pulse pressure $\times$ pulse rate $\div$ diastolic pressure
22. McCurdy-Larson Organic Efficiency Test [11]

Experimental Method.—The swimmers were all examined previous to the "time trials" for the 440-yard free style swim. Immediately after completing the distance they were removed from the pool for the measurement of pulse rate for one minute. In the original group of 20,

[8] J. B. Barach, "The Energy Index (S. D. R. Index) of the Circulatory System," *Arch. of Internal Medicine*, 24:5 (Nov. 15, 1919) 509–513.

[9] W. J. Stone, "The Clinical Significance of High and Low Pulse Pressures with Special Reference to Cardiac Load and Overload," *J. A. M. A.*, 61:14 (Oct. 4, 1913) 1256–1259.

[10] B. Smith, "Blood Pressure Studies in Five Hundred Men," *J. A. M. A.*, 71:3 (1918) 171.

[11] J. H. McCurdy and L. A. Larson, *The Physiology of Exercise* (Philadelphia: Lea and Febiger, 1939) 315–336.

a large number of measures were secured after the 440-yard swim. The pulse rate after the 440-yard swim seemed to have the highest degree of validity, therefore it was retained for further experimental work.

After further experimental work it was decided to drop this item.

The infirmary group was examined after the temperature caused by the respiratory infection had been returned to normal. It was our desire to examine subjects when in a weakened state, physiologically, as this group would yield an excellent criterion for the selection of physiological items. It was later demonstrated that a significant physiological change takes place as the result of respiratory infection, such as, colds, grippe, etc. (73 cases previously cited).

ANALYSIS OF RESULTS

Statistical Method.—The data were treated statistically in two ways: first, correlations were calculated between the circulatory-respiratory measures and the "time" for the 440-yard swim with 52 mechanically efficient subjects, and second, bi-serial [12] correlations were calculated between the circulatory-respiratory measures and the good-poor criteria, using the 100 swimmers (60 varsity, 40 Olympic) as the good criterion, and 138 infirmary subjects as the poor criterion. In both cases a number of multiple correlations were calculated to determine the best combination of items.

Physiological Results. — Only the significant correlations with the criterion measure are listed (Table I). These correlations served as the matrix for further statistical analysis to determine the best physiological combination for each criterion of physiological fitness. The multiple combinations did not include sitting and standing diastolic pressures together because of the high intercorrelation (physiological indication nearly the same). This was also the case with the pulse pressure ÷ systolic and the pulse pressure ÷ diastolic in the standing position as well as these two variables in the sitting position. Combinations therefore included these two variables (PP ÷ systolic and PP ÷ diastolic) in different positions (Sit. PP ÷ Sit. Dias. and Std. PP ÷ Std. systolic; and Std. PP ÷ Dias. and Sit. PP ÷ Sit. systolic) when in the same combination. This gave additional physiological information.

The multiple combination with the good-poor criteria showing the best combination is sitting diastolic pressure, breath-holding 20 seconds

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[12] The bi-serial formula used is the one recommended by Richardson and Stalnaker for data not satisfying the assumption underlying the usual formula, that of normality of distribution in the dichotomous variable. In the case where this assumption is not fulfilled it has been found by Larson that the Richardson-Stalnaker formula $\sqrt{pq}$ approaches the product-moment correlation more closely than the other formula usually used:

$$\frac{pq}{z}$$

In the case where the assumption is fulfilled the $\sqrt{pq}$ formula yields lower correlations than the product-moment.

TABLE I
SIGNIFICANT CRITERION CORRELATIONS *
(Physiological Variables)

Number of Variables	Physiological Variables	Correlation with Endurance Criterion: Time for 440-yard swim	Correlation Good-Poor Criteria
1	Sitting diastolic	—.4406	—.6310
2	Standing diastolic	—.5792	—.2844
3	Breath-holding after ex.	—.3807	.5354
4	Vital capacity	—.4062	.3302
5	P.P. ÷ systolic (sit.)	.3025	.6135
6	P.P. ÷ systolic (std.)	3569	.4355
7	P.P. ÷ diastolic (sit.)	.3248	.6354
8	P.P. ÷ diastolic (std.)	.3501	.4653
		$N = 52$	$N = 238$

* Only the significant correlations are listed. The correlations should be interpreted according to *size* and not *sign*. The physiological relationships are consistent. Variations in sign result from the arrangement of the variables correlated.

after exercise,[18] vital capacity,[18] and standing pulse pressure ÷ standing systolic pressure (Table II). The multiple correlation is .8218. It is interesting to note that these same items produce a significant correlation with the "endurance" criterion (.6433). The selected combination

TABLE II
STATISTICAL ANALYSIS FOR BEST PHYSIOLOGICAL COMBINATION*

Best Combination for Endurance in the 440-yard Swim	Best Combination for the Differentiation of the Good-Poor Groups
$R_{0.13458} = .6412$	$R_{0.13458} = .7446$
$R_{0.23458} = .6804$	$R_{0.23458} = .7051$
$R_{0.13467} = .6433$	$R_{0.13467} = .7738$
$R_{0.23467} = .6821$	$R_{0.23467} = .7500$
$R_{0.1346} = .6433$	$R_{0.1346} = .8218$†
$R_{0.2346} = .6618$	$R_{0.2346} = .6583$
$R_{0.1347} = .5816$	$R_{0.1347} = .7381$
$R_{0.2347} = .6823$	$R_{0.2347} = .7154$
$R_{0.1348} = .6434$	$R_{0.1348} = .7415$
$R_{0.2348} = .6679$	$R_{0.2348} = .6450$
$R_{0.134} = .5603$	$R_{0.134} = .7124$
$R_{0.234} = .6855$	$R_{0.234} = .6886$
$R_{0.13} = .5700$	$R_{0.13} = .7080$
$R_{0.23} = .6535$	$R_{0.23} = .5672$
$R_{0.1345} = .5825$	$R_{0.1345} = .7308$
$R_{0.2345} = .6772$†	$R_{0.2345} = .7018$
$R_{0.1358} = .6380$	$R_{0.1358} = .7497$
$R_{0.138} = .6326$	$R_{0.138} = .7387$

*The numbers in the Table refer to the variables in Table I; for example, 1 = sitting diastolic pressure. $R_{0.12\ldots n}$ = multiple correlation between the criterion measure (O = Time; O = typical groups) and variable (1 = sitting diastolic pressure) 2 = std. diastolic, etc.
† The selected battery of tests for each of the two criteria.

[18] This is determined by the Flarimeter Test. See McCurdy and Larson, *The Physiology of Exercise.*

for endurance included these same physiological items with two differences: standing diastolic pressure contributed more toward the prediction of endurance condition than did sitting diastolic pressure, and sitting pulse pressure ÷ sitting systolic pressure more than the item in the standing position. The multiple correlation is .6772. The selected battery for endurance correlates significantly with the good-poor criteria (.7018).

These results are important in that not only do these items differentiate between the physiologically good and poor but also correlate significantly with endurance. This gives additional validity to the good-poor criteria used in the development of the Organic Efficiency Test. Those people standing low on the physiological curve do not have endurance ability which is a real test of the efficiency of the circulatory-respiratory function.

PHYSIOLOGICAL INTERPRETATIONS

Summary Analysis of Variables.—1. Standing Pulse Rate. The Olympic swimmers are slightly lower and less variable in standing pulse rate (Table III). A slightly higher rate is found in the infirmary group, with significantly greater variability.

TABLE III
PHYSIOLOGICAL VALUES FOR TYPICAL GROUPS

Physiological Items	Springfield College Freshmen (639)	Olympic Swimmers (40)	Springfield College Varsity Swimmers (60)	Springfield College Infirmary Patients (138)
Std. pulse rate	$M =$ 81.84 $\sigma =$ 11.42	$M =$ 81.30 $\sigma =$ 9.72	$M =$ 83.60 $\sigma =$ 12.08	$M =$ 84.72 $\sigma =$ 13.56
Sitting diastolic pressure	$M =$ 70.45 $\sigma =$ 10.10	$M =$ 72.10 $\sigma =$ 4.80	$M =$ 78.00 $\sigma =$ 6.36	$M =$ 88.72 $\sigma =$ 8.80
Standing diastolic pressure	$M =$ 85.01 $\sigma =$ 9.32	$M =$ 85.60 $\sigma =$ 6.46	$M =$ 87.60 $\sigma =$ 5.60	$M =$ 93.94 $\sigma =$ 8.64
Breath-holding 20 secs. after ex.	$M =$ 28.51 $\sigma =$ 10.38	$M =$ 42.00 $\sigma =$ 10.92	$M =$ 32.85 $\sigma =$ 9.60	$M =$ 24.00 $\sigma =$ 7.64
Vital capacity	$M =$ 4937.75 $\sigma =$ 760.00	$M =$ 6200.00 $\sigma =$ 680.00	$M =$ 5640.00 $\sigma =$ 680.00	$M =$ 5320.20 $\sigma =$ 810.00
Std. pulse pressure ÷ std. systolic	$M =$ 29.84 $\sigma =$ 8.11	$M =$ 29.25 $\sigma =$ 6.40	$M =$ 29.67 $\sigma =$ 6.80	$M =$ 22.93 $\sigma =$ 6.42
Sit. pulse pressure ÷ sit. systolic	$M =$ 39.46 $\sigma =$ 8.52	$M =$ 40.75 $\sigma =$ 4.71	$M =$ 36.93 $\sigma =$ 6.33	$M =$ 27.73 $\sigma =$ 6.90

2. Diastolic Pressure. The poor group has a significantly higher diastolic pressure than the other groups in both the sitting and the standing positions (Table III). The good groups have the same mean values (within sampling error range) but the variability is significantly greater in the freshman group than in the athletic groups. This means that there are considerably more high and low pressures in this group.

3. Respiratory Measures. The breath-holding after exercise is significantly greater in the athletic groups; the Olympic group is superior (Table III). The vital capacity is also greater in the Olympic group. These groups are comparable in this item because of the same average age and weight.

4. Pulse Pressure ÷ Systolic Pressure. This item is significantly lower in the standing position than in the sitting. This is true to the same degree in the good group and in the poor group (Table III). In both positions the poor group is significantly lower than the other good groups. The Olympic group is the least variable although not significantly so.

Significance of Physiological Variables. — The individual physiological test items indicated that the athletic group (swimmers) is physiologically superior. The question is, to what degree can one predict the physiological efficiency differences of the individual athletes (swimmers)? Using the conventional methods of score form regression equation development, standing diastolic pressure, breath-holding 20 seconds after exercise (flarimeter test), vital capacity, and standing pulse pressure ÷ standing systolic pressure were combined into an equation using "time" for the 440-yard swim as the criterion measure. It was found in scoring each of the 52 skilled swimmers with this equation that the actual time was indicated to an average error of 7.25 per cent. This is significant in that not only does this equation differentiate between the physiological good and poor groups (r_{bis}=.7018), but it also indicates according to the equation the physiological rank with the "time" rank to a correlation of .6772. This means that the rank given by the equation will indicate quite closely the rank within the group in endurance condition. This equation is:

$$\overline{X}_0 = -2.96X_1 - 1.14X_2 - .012X_3 + 1.30X_4 + 688.50(\pm 29.61)$$ [14, 17]

$\overline{X}_0$ = Rank in physiological function in terms of endurance condition for the 440-yard swim
X_1 = Standing diastolic pressure
X_2 = Breath-holding 20 seconds after standard exercise
X_3 = Vital capacity, with body temperature correction
X_4 = Sit. pulse pressure ÷ sit systolic pressure

[14] *Scoring Example:*

Physiological Values			*Score*	
X_1 = Std. diastolic pressure	=	68	−2.96 × 68	= −201.28
X_2 = Breath-holding after ex.	=	20	−1.14 × 20	= − 22.80
X_3 = Vital capacity	=	4310	−.012 × 4310	= − 51.72
X_4 = Sit. pulse pressure ÷ sit. systolic	=	46	1.30 × 46	= 59.80
			Constant	= 688.50
			Algebraic Sum	= 472.50

Norm: (see note 23, page 11). Range for this sample is 472.50 to 304.08. The low score is indicative of superior physiological efficiency. In this example 472.50 indicates very poor physiological efficiency, with an actual swimming time of 485.45 seconds for the 440 yards (free style). The score 304.08 indicates excellent physiological efficiency with the swimming time of 317.20 seconds for the 440 yards (free style).

To what degree can one predict physiological poor and good function when the entire physiological curve is taken into consideration? As would be expected, this prediction can be made in a more valid way (r_{bis}=.8218) than it can within a superior group in terms of individuals (.6772).[15] An equation[16] was developed using the most valid physiological combination (.8218). This equation is:

$$\overline{Z}_0 = -2.82Z_1 + 1.87Z_2 + 1.00Z_3 + 1.72Z_4 (\pm 41.36)$$ [17]

$\overline{Z}_0$ = Rank in circulatory-respiratory function in terms of a total curve. (See note 22, page 11).

Z_1 = Sitting diastolic pressure (standard score) [18]

Z_2 = Breath-holding 20 seconds after exercise (standard score) [19]

Z_3 = Vital capacity (standard score) [20]

Z_4 = Std. pulse pressure ÷ std. systolic pressure (standard score—Table IV)

TABLE IV

STANDARD SCORES FOR STANDING PULSE PRESSURE DIVIDED BY STANDING SYSTOLIC PRESSURE

Raw Score	Z-Score	Standard Score* 14 (Z-Score) + 50	Raw Score	Z-Score	Standard Score* 14 (Z-Score) + 50
47	2.874	92	27	.168	52
46	2.739	88	26	.033	50
45	2.603	86	25	— .102	49
44	2.468	85	24	— .238	47
43	2.333	83	23	— .374	45
42	2.197	81	22	— .509	43
41	2.062	79	21	— .644	41
40	1.927	78	20	— .779	39
39	1.791	75	19	— .915	37
38	1.656	73	18	—1.050	35
37	1.521	71	17	—1.185	33
36	1.386	69	16	—1.321	32
35	1.250	68	15	—1.456	30
34	1.115	66	14	—1.591	28
33	.980	64	13	—1.727	26
32	.844	62	12	—1.862	24
31	.709	60	11	—1.997	22
30	.574	58	10	—2.132	20
29	.438	56	9	—2.268	18
28	.303	54			

Standing Pulse Pressure ÷ Standing Systolic Pressure

$M = 25.76$

$\sigma = 7.39$

* This is a more convenient form than the Z-Score.

[15] Checked by correlating "Predicted" with "Actual" time (.6704).

[16] The Z-score form equation using the Beta weights as multipliers for standard scores.

[17] Standard Error of Estimate. This indicates the likely fluctuation in the score in repeated measurements; 68 per cent falling between 41.36 limits.

[18] See McCurdy-Larson, *The Physiology of Exercise*, p. 321 (standard score without weight).

[19] *Ibid.*, p. 322 (standard score without weight).

[20] *Ibid.*, p. 325 (standard score without weight).

CONCLUSIONS

1. The statistical equation including standing diastolic pressure, breath-holding 20 seconds after exercise, vital capacity, and sitting pulse pressure ÷ sitting systolic pressure is valid as an index of the functional condition of the circulatory-respiratory systems for endurance swimming. This equation yields a predicted score in "time" (seconds) for the 440-yard swim and is applicable under the following conditions:

a) To men of the same mechanical swimming ability as the Springfield College swimmers (free style).[21]

b) To physiological values that fall between the following limits:

(1) Standing diastolic pressure	65	to	100
(2) Breath-holding after exercise	19	to	60
(3) Vital capacity	4200	to	7200
(4) Sit. pulse pressure ÷ Sit. systolic pressure	25	to	50

2. The statistical equation including sitting diastolic pressure, breath-holding 20 seconds after exercise, vital capacity, and standing pulse pressure ÷ standing systolic pressure is valid as an index of the functional condition of the circulatory-respiratory systems in terms of the "total physiological curve." [22] This equation yields a total weighted standard score and is applicable under the following conditions: [23]

a) To the male age group of 18 to 24

b) To the physiological values that fall within the following limits:

(1) Sitting diastolic pressure	40	to	110
(2) Breath-holding 20 seconds after exercise	10	to	90
(3) Vital capacity	2500	to	7500
(4) Standing pulse pressure ÷ standing systolic pressure	9	to	47

The writers wish to acknowledge help given in the statistical work by Mr. Herleik Quamme, Graduate Assistant.

[21] It has been demonstrated that this equation is not applicable to Olympic swimmers.

[22] The swimming and infirmary groups represent the extremes of the normal physiological curve as shown when combined with 500 college freshmen scored by this same equation. This is considered total only in the sense of this population. Other experiments may show higher and lower values. The curve formed by these groups is normal.

[23] Norms are not presented in this publication but will follow later. Until that time the test can be used to show individual differences within a group without knowing the position of the group on the total curve.

Physiology and the Physical Educator

Recent Advances in Applied Physiology and Their Implications for Physical Education

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FOR more than twenty-five years the Department of the University which I represent has maintained a special staff and a separate laboratory devoted exclusively to the particular needs of physical education students. Its teaching and research assistants have been consistently selected from among students who had pursued at least their undergraduate study in the field of physical education, a number having even had a modest teaching experience. Its published studies exemplify how much the undergraduate professional student can contribute to the furtherance of a fundamental research program.

The Laboratory of Physical Education Physiology of the University of Wisconsin early fell heir to a rich heritage in the philosophy of its first professor. For fifteen years, Percy Millard Dawson carried on a vigorous campaign of propaganda for "intellectualism in physical education." My own attitudes were powerfully influenced by him, for I served in turn as his student, assistant, and successor.

It was my privilege to spend the 1938-39 school year in research abroad, working with Docent Král in the Medical Research Division of the Czechoslovak Sokol (Gymnastic) Union, at Charles University in Prague. I have described elsewhere the ideal of service to the Sokol through science, which has long found among its several outlets an admirable and extensive program of research pertaining to exercise.[1]* This is carried on under the leadership of men of the highest rank in the medical profession of Czechoslovakia. All Sokols, familiar with the philosophical and practical aspects of this organization's exercise program, these investigators are in a unique position to appreciate its problems, sense their importance, and bring to bear upon them the fruits of a rich and varied scientific experience. The Medical Division of the Czechoslovak Sokol Union offers an unexcelled example of what can be accomplished in the way of significant exercise research intimately related to the especial needs of a particular physical education program. Král had represented Czechoslovakia at the meetings of the International Association of Sport Physicians, and had been a member of the Physical Education Commission of the League of Nations. It is

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A paper presented before the Central Association for Physical Education of College Women, Wichita, Kansas, March 1940.

* Refer to numbered Bibliography at end of article.

inevitable that my sense of values should have been modified by things witnessed during so historic a year, spent as it was in the shadow of a great counter-revolution against intellectualism and enlightenment. Here in this land we still believe in truth, in the dignity of human thought and reason. Appreciating the significance of intellectual freedom as never before, I shall seize this opportunity to bombard you with conflicting viewpoints, confident of the spirit in which you will receive them, for tolerance has always loomed large in the evolution of your profession.

Physiology is important in a utilitarian way. There has been astounding progress in this branch of human knowledge in the past several decades. That it is no longer a science of purely academic interest but one of deep significance for the welfare of mankind has become abundantly evident. The League of Nations Commission on Physical Education recently appointed Hansen, Director of the Institute for the Theoretical Study of Gymnastics in Copenhagen, and McSwiney, Professor of Physiology, St. Thomas Hospital, London, to make a survey of the widespread and vigorous continental movement to stimulate interest in disciplined exercise.[2] The British physiologist, Cathcart, reviewed the contributions of physiology to "the basis of National Fitness."[3] People must want to be fit and they must be prepared to pay the price, which is steadfastness and discipline. Sir Stanley Woodward set forth the thesis of interdependence between nutrition and physical training.[4] One cannot be considered without the other. Only when physical training and good feeding go hand in hand can worthwhile results be achieved. It is tragic indeed to see the German scientist prostituting his learning in a vain effort to justify forced minimal food rations on the basis of "newer views" which purport to place previous protein levels for the sportsman as too high. The last two years have yielded a veritable flood of discussion in all the scientific journals of Europe and Great Britain concerning "the dangers of physical illiteracy," "the importance of a healthy stock," "the optimal attainment of work capacity," "the benefits of exercise," *"travail et joie pour le pays et pour le roi."* The analysis of these urgent suppositious contributions emphasizes how much of importance in the physiology of man at work still remains a matter of empirical practice. Krogh, the eminent Danish physiologist, speaking before the American Academy of Arts and Sciences not many months ago, expressed his belief that the teaching of the science of physiology has not kept pace with its increasing significance for the welfare of mankind.[5] It should be taught to a larger number of people and in a vastly more effective way.

The machinery of the human body was designed to enable easy and efficient movement. It functions best when used in ways for which it has been specifically adapted. *Prima facie,* at any rate, that appears to be a logical premise from which to commence arguments in support of

exercise as a physiological necessity, and one which receives almost universal support. Granted that physical activity is obligatory for healthful living, must that exercise be of a specific kind in order to achieve its desired ends? Firstly, then, we must differentiate between *exercise* and *physical education*. They are by no means synonymous. In his classical monograph, Bainbridge concludes that "Fortunately for most people, the exercise consequent upon the ordinary activities of life is sufficient to maintain the body in a state capable of responding adequately to usual effort. It is a question whether the majority of people in good health require any additional exercise. General experience would appear to answer this question in the negative, except only in so far as exercise may be a pleasant diversion." [6]

The ordinary activities of everyday life may fit the human being for ordinary living, but how good is the ordinary machine which results? In collecting data on the physical condition of the people, we draw upon diverse sources such as insurance statistics, the incidence of military rejections on physical grounds, the examination of school children, the vast majority of whom seem to be imperfect specimens, and the room we find for physical improvement among our college students. The statistics which result may be made to sound very disconcerting. However, they give rise to the unequivocal necessity of making a second realistic differentiation: *fitness for useful living vs. super-states of fitness* enabling one to perform unusual feats of strength, skill, or endurance.

A number of years ago Steinhaus examined into the practical purposes for which ordinary people participate in physical activities and then asked what evidence we have that exercise really achieves any of these objectives.[7] He believes, and I agree with him, that it is the duty of the physical educator who supervises and administers the exercise programs of these typical people, to know the truth about the claims which so often motivate participation. There is sure proof that exercise can modify the machine when severe enough and participated in systematically over long periods of time. In his Guggenheim Fellowship paper, "The Chronic Effects of Exercise," Steinhaus has given us an admirable resume of the experimental evidence in support of this contention.[8] It must be obvious, however, that we have no right to assume that the desirable concomitants of systematic exercise of a type known to produce the trained state are also the inevitable consequence of the average program of compulsory or recreational physical education. To my knowledge no comprehensive scientific attempt has ever been made to objectively evaluate the physiological effects of the routine physical education program, even though its supposed health-producing objectives are cited with conspicuous frequency in justification of the place it demands in the school budget and curriculum.

The trained state remains only so long as systematic activity is con-

tinued. The very real benefits which accrue as a result of disciplined physical labor under good nutritive and environmental conditions are quickly lost with the cessation of regular exercise. To maintain them would be a costly and time-consuming occupation which few can afford, driven and stimulated as we are by a competitive system and social order which places a greater premium upon intellectual, moral, and spiritual qualities than motor skills and physical endurance. We place no premium upon super-states of fitness, save as they delight us in those rare individuals who participate with great success in the competitive athletics we enjoy as spectators. Ordinary life as we live it, particularly that of our women, puts relatively little strain upon the physical machine. We can, and indeed most of us do, meet it adequately in the untrained state.

There is an enormous difference in the contemporary attitudes of the average American and European toward physical fitness achieved through disciplined exercise. This cannot fail but impress anyone who has visited abroad in recent years. Steinhaus observed in one of his latest papers that physical education develops rapidly and powerfully whenever it becomes allied with nationalistic drives motivated by threats against the integrity of racial groups, but *"lacks vitality when free from some cause greater than itself."*[9] This should give us pause as we continue to enunciate our objectives. The National Fitness Council of Great Britain is fostering a gigantic cooperative effort on the part of the general practitioner, the layman, school medical groups, community centers, various social hygiene agencies, and the fighting services to meet the challenge of the hour: "Be Fit, Keep Fit, Make Fit." Opportunity for physical training without regimentation was conspicuously successful in Czechoslovakia, the history of whose fitness movement dates back to the national awakening of the Czech people in the 19th century. Different levels of acceptable fitness are in vogue among various peoples, the optima in force in any given country being motivated largely by sociological, psychological, economic, and military forces rather than any innate desire to be fit. These optima seemed, in the months prior to the war, to be geared to a higher level among European peoples than that which satisfies the demands of our comparatively placid existence. One cannot help but wonder if motivating forces less violent than the horrors of destruction through war are ever strong enough to effectively inculcate desires to be fit. Steinhaus reminds us of the relationship of the flowering of physical education in our own country to the advent of the World War.[9]

Armed with these somewhat disquieting viewpoints, let us examine the recent advances in applied physiology. They have implications for physical education. Some of these are direct, simple, and obvious. The physiologist has an abstract interest in the mechanism of a variety of phenomena which differentiate the quiescent from the active organism.

Like the clinician, he often utilizes exercise as a test strain through the application of which the functional capacities of the machine may be evaluated. He has no interest in the direct application to practical exercise problems of the phenomena he observes. He does not possess sufficient knowledge of the techniques of the administration of exercise to large groups to enable him to put his hypotheses to the practical test in natural sport situations. On the other hand, those practically interested in man at work, be it industrial, educational, or recreative, largely limit their attention to methods of testing and improving performance. They are often the archivists of facts gathered through the use of methods empirical in their origin. As a rule they are neither interested in *why* certain results accrue, nor *how* the machine was able to respond in the ways indicated by the data they collect.

It may be surprising to discover how wide is the interest in exercise and how many are the workers, representing laboratories in all parts of the world, who push back the frontiers of human knowledge, adding immeasurably to the richness of your profession and the strength of the concepts which form the foundations upon which the technical aspects of exercise administration must rest.

Skĕrlj, a Jugoslav who studied under a Rockefeller grant at the Physical Education Institute in Warsaw, made an extensive anthropometric investigation of picked Polish athletes and concluded that intensive sport participation affects the female more than the male, favoring the development of infantile and virile body types and a high incidence of menstrual irregularity.[10] It is his considered opinion that women should not commence intensive professional training in physical education until after the age of 21.[11] Adams obtained no evidence that hard labor during youth tends toward the development of a significant degree of maleness in the build of young American colored women,[12] and Carpenter found that when it occurs, masculinity of build has a favorable influence upon athletic performance.[13] She has also written a scholarly resume of the practical strength-testing literature.[14] Anthropometric studies are especially popular among Balkan investigators.[15-21]

The literature on posture is enormous and each year yields increasing numbers of fundamental contributions. These are concerned with such diverse topics as the neck and labyrinthine reflexes,[22-24] the mechanism of tonus,[25-27] standing as a geotropic reflex,[28] the influence of posture on the regulation of respiration and circulation,[29-35] and the importance of postural sway in the prevention of syncope.[36] Our own physiological study of posture is now in its fifth year. I should like to discuss it in some detail because several of its implications are of practical importance to physical education.

We were interested originally in devising a simple piece of equipment that would enable us to place an experimentally determined gravity line into routine posture pictures. When a girl assumed a natural

stance upon such a platform, we observed that her center of gravity shifted incessantly. Lovett had noted this 30 years ago when he first described in principle the method we were using. To evaluate this phenomenon we constructed a compound watt oscillograph that reproduces the dancing center of weight during normal standing and arranged our apparatus so that we could project the oscilligram obtained into a print of the base of support.[37, 38] Studying individuals of both sexes ranging in age from 3 to 80, we observed that postural sway is inseparable from the upright stance.[39] Standing is, in reality, *movement upon a stationary base.* However, in every individual thus far observed, the average location of the center of weight comes remarkably close to the geometric center of the area of underpropping and we found it exceedingly difficult to disturb this apparently fundamental relation of the center of gravity to the supporting base.[40] The multijointed human machine is so beautifully constructed that every infinitesimal loss of balance is instantly met by postural readjustment, the average location of the center of weight remaining over the center of the base. Thus stance becomes a series of constantly shifting alignments. Postural asymmetries occur as transient physiological adaptations to involuntary variations in the location of the center of weight. In our experience, the upright stance is asymmetrical in the majority of young adult women,[41] confirming the observation of Reynolds and Hooton.[42] Sweigard's critical analysis of a large number of X-ray observations made upon the standing subject led her to conclude that asymmetry in the alignment of the skeletal framework is a universal finding.[43] It seems that the patterns of bilateral symmetry which she describes must be the result of changes in the location of the center of weight. From the sum total of these observations it follows, on *a priori* reasoning, that evaluating posture by instantaneous photography is fallacious in principle. Whether the errors induced by postural sway are sufficiently great to invalidate objective photographic posture tests remains to be determined.

The belief that "good posture" is mechanically and physiologically advantageous has been abundantly expressed. It has long been taught, first, that deviations from this standard are associated with visceral malpositions which impair function, and second, that a less exact alignment of the head, spine, and appendages calls into play fatiguing contractions for the equilibration of large gravitational rotatory stresses. These concepts are supported almost exclusively by *a priori* reasoning and empirical evidence. An exception is the work of Laplace and Nicholson, who attempted to measure changes in visceral function with postural correction.[44] Of the two assumptions presented so commonly in justification of "good posture," the one concerned with its metabolism is amenable to direct experimental attack. Since the cost of standing is dependent upon the magnitude of the rotatory moments which must be

equilibrated by muscular contraction, we set about evaluating the energy metabolism during systematically graded degrees of gravitational stress. General metabolism varies as do all other physiological functions. The additional cost of standing barely exceeds this and is insignificant when compared with the greatly augmented expenditure of voluntary muscular contraction.[45] *Standing is remarkably cheap.* It is maintained with extraordinary economy, a finding which argues against current concepts of the fatigue of poor posture.[46]

It is known that the circulation to the head-end of the organism may be sufficiently reduced during standing to bring on syncope. The sense of exhaustion associated with rigid upright stances disappears when the hydrostatic effect of gravity on the circulation is nullified. We believe that postural sway converts the antigravity muscles into an accessory pump which aids the venous return sufficiently to prevent syncope.[47] In our experience, relaxed, comfortable standing is indefatigable. One suffers only from boredom. Just as soon as postural sway is prevented, either by strong voluntary contraction such as characterizes the rigid military posture, or by fixing the subject with mechanical restraints so that sway cannot occur, the heart rate accelerates, the pulse pressure falls, and sooner or later most normal subjects faint.

Mateeff first called attention to the fact that collapse quickly supervenes if an individual is made to stand after the completion of even brief violent exercise.[48-50] Brogdon has found that when the post-exercise stance is relaxed and associated with normal postural sway, few cases of gravity shock occur.[51]

The biodynamics of human locomotion, terrestrial and aquatic, have been studied respectively by Elftman[52, 53] and Karpovich and Pestrecov.[54] An interesting departure in the investigation of muscle action is Stewart's moving picture analysis of gait variations following partial destruction of the tendon of insertion of one or more groups acting on a joint.[55] Probably the best laboratory for the study of the biodynamics of locomotion is that of Bernstein in the All-Union Institute of Experimental Medicine in Moscow. Instead of the laborious moving picture analyses which we use in this country, Bernstein has developed a device which enables him to obtain one cycle of a movement upon a single stationary plate, the cycle being broken into 15 or 20 discrete pictures.[56]

There is considerable in the neurological literature on motor learning. The cortex exerts a protective inhibitory control over the lower motor neurons. Langworthy and Richter found that after removing the frontal poles of the brain, so great was the release from this normal inhibitory control, that some of the animals died from overexhaustion.[57] One wonders whether some humans may not be motor morons because of congenital deficiencies in inhibitory control. No amount of physical education can make champions of them. From a study of after-contrac-

tion, Sapirstein and his associates reason that this phenomenon may play some role in the training of motor habits.[58] When a baseball player warms up by swinging two or three heavy bats before going to the plate, he is probably taking advantage of the cortical after-discharge. The issue between the "total pattern" and the "reflex theory" of motor learning has been discussed by Barcroft and Barron[59] and by Kuo.[60] Neither school has yet secured sufficient convincing evidence. Practical studies of motor learning with implications of physiological interest come largely from your own profession. Wild, for example, analyzed the growth of the ball-throwing pattern between the ages of 2 and 12,[61] and Keeler studied the effect of maturation on skill at a higher age level.[62] Irwin found that a higher percentage of children were ambidexterous with respect to the feet than the hands but that many, performing physical activities right-handedly through education, were inherently ambidexterous.[63]

Of considerable theoretical and some practical importance is the most recent revolution in muscle physiology. According to the classical view, the actual shortening process is the consequence of chemical reactions requiring no oxygen. However, evidence is accumulating which suggests, as Sacks of Michigan has contended, that this may be only an emergency mechanism, called upon during the circulatory adjustment at the onset of work and during exercise too violent to enable an adequate oxygen supply to support an aerobic metabolism.[64, 65] During exercise in the steady-state, the driving force is derived directly from the combustion of fuel. Most of our exercise, particularly the non-competitive athletic participation of women, falls into this category. Newman, Dill, Edwards, and Webster investigated the rate of removal of lactic acid when gentle exercise replaces post-exercise rest.[66]. Thomas, working with Keys in the Laboratory of Physiological Hygiene at the University of Minnesota, has repeated these observations on women and concludes that the increased rate of removal of lactic acid as a result of moderate exercise may be due to its use as a fuel.[67] Continuation of exercise may be more recuperative than rest, paradoxical as that seems.

In a series of brilliant papers, Christensen and Hansen of Copenhagen have shown that work capacity is impaired and costly on a fat-rich diet.[68] If the carbohydrate stores were depleted by hard exercise, and if, when very fatigued, the subject was given sugar by mouth without interrupting the exercise, performance promptly improved. These experiments lend credence to certain empirical practices among athletes. However, to bring about fatigue associated with low blood sugars, Christensen and Hansen's subjects exercised to the point of collapse. This required several hours of uninterrupted gruelling physical effort. It is doubtful whether the average woman possesses the qualities necessary to give her the drive to push herself to such points when

motivating forces are no greater than those which usually accompany recreational, or even competitive exercise. One wonders therefore, if sugar feeding is of any importance in delaying the onset of fatigue induced by more moderate grades of exercise.

Comparatively little attention has been paid to the relation of protein to the performance of work and the onset of fatigue. It is interesting therefore to observe that Mirski and his associates have recently shown that the carbohydrate reserves of the liver laid down on a protein diet behave differently from those deposited on a diet of carbohydrate.[69] Experimental animals on a protein-rich diet regenerated fresh sugar so rapidly that no matter how heavy the exercise demand placed upon them, new sugar formation could occur. High protein diets appear to be advantageous in the support of heavy exercise.

One of the most interesting hoaxes of the year and one which speaks poorly for the credulity of the human mind, is the campaign for the use of the protein *gelatin* in the prevention of fatigue. In February of 1939, Ray, Johnson, and Taylor of the Long Island Medical School published a paper called *"The Effect of Gelatin on Muscular Fatigue'*..[70] News of this publication was immediately disseminated by the lay press. Within 24 hours the company which had subsidized the research was offering a free bulletin containing all the details of the tests, along with directions on how to benefit by the effects at home. Popular science articles soon followed in the widely circulated news weeklies. Advertisements advocating the use of gelatin for this new purpose began to glitter in numerous magazines, especially those catering to women, although Ray and his associates failed to demonstrate that this protein had any influence upon the onset of fatigue in the young adult female. Case history testimonials coming from physical education teachers have found their way into these advertisements with non-specific references to professional students benefiting from a gelatin regimen, and from 40 football coaches who added gelatin to the dietary of the training table. By the spring of 1939 a few sober voices were lifted against the patent medicine tactics employed by the sponsoring commercial interests, and in July, the Council of Foods of the American Medical Association dropped the product from the list of approved foods. The manufacturers had failed to submit the evidence for their claims before using them in lay advertising. The Council concluded that the evidence of Ray, Johnson, and Taylor was inadequate to prove that gelatin lessens or postpones fatigue.

Our laboratory has completed a study of the effect of gelatin on the power of women to perform anaerobic work.[71] Physical exercise, maximal anaerobic in type and constant as to the rate of working and speed, was performed to the point of exhaustion by six healthy young adult women. After a period of preliminary training varying in length in the different subjects, gelatin was added to the diet and its influence upon

the time of onset of muscular fatigue was noted. The evidence gathered substantiated the following conclusions: Gelatin has no effect upon the capacity of women to perform maximal anaerobic work, nor any apparent influence upon the improvement in power due to training. Gelatin does not prevent the development of "staleness" when brief work of extreme severity is repeated daily over a long period of time. To make a long story short, it is the consensus of opinion among those trying to confirm the work of Ray, Johnson, and Taylor, that the dramatic increase in work output attributed by these investigators to gelatin was probably only a physiological training phenomenon, gelatin having been introduced into the diet before the full influence of repeated exercise had had its normal effect.

Every year yields a large number of papers concerned with various aspects of the effect of tobacco smoking on health. A recent comprehensive examination of life extension statistics by Short, Johnson, and Ley indicates that symptoms referable to the respiratory, circulatory, gastro-intestinal, and nervous systems are definitely increased among smokers.[72] These findings are in accord with the recent report of the medical biometrist Pearl.[73] From the careful and critical application of actuarial methods to large samples of smokers and non-smokers, he demonstrated that the smoking of tobacco was statistically associated with an impairment of life duration. The degree of this impairment increased as the habitual smoking increased. However, those who survived to the age of 70 appeared to be such tough and resistant specimens that beyond the eighth decade the smoking of tobacco did them no further measurable harm.

Exercise physiologists have long thought that the rise in body temperature commonly associated with vigorous exercise is due to an inability of the body to lose heat fast enough to balance the increased heat production. Nielsen has recently published a series of experiments demonstrating that the level to which the body temperature rises depends upon the severity of the exercise and is uninfluenced by drastic changes in the temperature or movement of the surrounding air.[74] During work the temperature regulating center is merely adjusted to a higher level. It maintains the body at this level irrespective of the degree of heat loss as long as the exercise continues. The dangers of exercise in hot environments are amply discussed in Dill's recent book.[75] Hicks has demonstrated the rapid development of orthostatic collapse when standing occurs in a hot room.[76]

There has been considerable theoretical research on the influence of the hormones upon the power to perform work. We have long thought that the adrenals are concerned in the ability to do work. They gain in weight as early as 12 hours after the beginning of stress and their experimental removal in the rat is associated with a prompt loss in the capacity to perform work. Ingle postulates that this endocrine response

is probably mediated by the adrenotropic hormone of the pituitary gland. After hypophysectomy, work capacity rapidly decreased until all muscular responsiveness was lost.[77] Riml believes an adrenal stimulating material which he observed in the blood of sportsmen after a 10-kilometer race, is formed in the muscles.[78] Hall and Lindsay found that the spontaneous running of rats in revolving drums fell off when the thyroid gland was removed,[79] and Pedersen-Bjergaard and Madsen observed a diminution of spontaneous muscular activity in castrates.[80] This could be reversed by the administration of either the male or the female sex hormones, though it required many times the dose to produce muscular activity than that necessary to get typical effects on the reproductive tract. Milco examined the endocrines of 50 participants in the Balkan Olympics[81] and, with Ulmeanu, assayed the endocrine status of students in the Rumanian Institute of Physical Education at the beginning of their studies and seven months later.[82] However, comparatively few attempts have been made to study endocrine effects upon work performance in man. The field is a richly fertile one of no small interest to practical physical education.

The female is, in general, less suited to rigorous exercise calling for sustained effort than is the male. As methods of detecting the exact location of a woman in her menstrual cycle become more and more precise, we may learn much concerning physiological variations in her capacity to meet physical stress. Since the advent of accurate calendar records of the menstrual rhythm, overwhelming evidence has accumulated indicating that the regular 28-day cycle is a phenomenon rarely seen. Rork has recently shown that the physiological variation in the length of the menstrual cycle of pubescent girls is especially marked.[83] Evidence is also accumulating which indicates that menstruation unaccompanied by ovulation, so-called "anovulatory cycles," often occurs in apparently normal adults. Rubenstein has recently reported that one out of every three cycles may be unaccompanied by ovulation.[84] Every girl should be taught how to keep accurate calendar records of her menstrual rhythm. If kept over a period of years, satisfactory estimates may be made of the probable dates of ovulation, the sterile and the fertile periods in the menstrual cycle. These concepts might well be incorporated into the hygiene lectures of the physical education teacher. It would be wiser for the girl to learn these important practical developments in reproductive physiology thus than gain them from the pseudoscientific literature now so abundantly available.

Strugurescu reports transitory modifications of the menstrual function among athletic women which disappear with the cessation of heavy exercise programs.[85] Muscular work had a favorable influence upon some. He concluded that there should be no prohibition of physical activity during the menses. Exercise had no detrimental effect upon fertility, and the supposed increase in the strength of the pelvic floor

musculature resulting from participation in competitive athletics appears to have no pathologic influence upon labor.[86, 87]

Schmid has studied the sport albuminuria of subjects varying in age.[88] He related the incidence of albuminuria and its amount to the equality of contestants, attack *vs.* defense, championship *vs.* friendly contest, training, style of play, and the nature of the terrain. For example, the soccer "goalie" and fullback had no albumin, although it was present in 50 per cent of the attacking wings and in 25 per cent of the wing defense players. Schmid concludes as others have, that the albuminuria of exercise is transitory and probably benign. It is a common phenomenon. We observed it in women following laboratory exercise on the bicycle ergometer, but little is known concerning its incidence in association with natural sport activities. Naeraa conducted an exhaustive study of the microscopy of the urinary sediments, applying his methods to 6-day bicycle racers in Copenhagen.[89] The number of casts increased steadily during the race, but without exception they remained hyaline in type, giving support to the conclusion that no damage to the kidneys can be attributed to even this very strenuous physical exertion. Among kidney function tests, the Donaggio reaction has been most studied by Italian and French investigators.[90] It has been recommended as a test of fatigue.[91] Certain urines inhibit the passage of thionin through ammonium molybdate. The color which results may be graded, and this varies with the intensity of the exercise and its duration, being minimally affected in light athletics, progressively more so as a result of swimming, boxing, skiing, and cycling.

There is a large literature on the hazards of exercise and the casualties of sport. For example, the elbow injuries of javelin throwers,[92] the knee joint injuries common to skiing,[93] rupture of the tendo-achilles while playing volleyball,[94] the epigastralgia of exercise,[95] "punch-drunkenness" and its mechanism,[96] asymmetrical development in unilateral sports,[97] predisposing causes for sport accidents,[98] and so forth. Thorndike has published a monograph on athletic injuries, their prevention and treatment.[99] Cassinis discusses the professional illnesses of Italian athletes.[100] They are most prevalent early in training, because of inexperience coupled with poor neuromuscular skill, and reach their highest level among champions who, excessively confident, live most dangerously and attempt the unattainable. The goal of Italian sport medicine is to be able to say that no disease exists among athletes related specifically to athletic activity. Speidel has made photomicrographic moving pictures of injury and repair of muscle fibers.[101] The most vulnerable place is the muscle-tendon junction. Boyle contributes an experimental analysis of the phenomenon of muscle soreness,[102] and Maison has published a series of papers on the mechanism of muscle pain.[103] Banting and his associates have made a study of the mechanism of experimental drowning.[104] Grubb describes a case of near drowning due to physical

allergy to heat, the rise in body temperature incidental to exercise leading to loss of consciousness while swimming.[105] Roth has just reported her experiments on the stimulation of gastric secretion induced by immersion of the body in cold water.[106] She argues that cold immersion gives rise to a histamine-like response of the stomach. Her observations are important because in subjects hypersensitive to cold, the histamine liberated may be shock producing. Brodgon, Horne, and Rork are studying the incidence of cramps in routine college swimming classes, and relating their presence to the character of the last meal, fatigue, and other factors.[107] Several papers have appeared on the hygiene of swimming, in particular its relation to infection of the upper respiratory tract and the accessory sinuses.[108, 109]

Physiology as it is taught in our universities and medical schools is primarily that of the young adult. Relatively little is known about the physiological status of other age groups, particularly in respect to exercise. Several notable attempts to learn something of age physiology have been made recently. Robinson, of the University of Indiana, has published a long and comprehensive study of the metabolic and cardiovascular-respiratory adjustments to exercise of a group of males ranging from 6 to 76 years in age.[110] McCurdy and Larson have given the Springfield Organic Efficiency Test to a group of males from 18 to 80.[111] Král,[112-116] of the Clinic for Sportsmen in Prague, has been conducting a long-time study of the influence of Sokol exercise on the heart size of adolescent males and females, champion Sokols, young adult soldiers, middle aged participants in the last festival games, and old men who had participated in regular Sokol exercise without interruption for 40 years. The All-Union Institute for Experimental Medicine in Moscow maintained a Clinic for Age Physiology. Upon the death of Gelman, two years ago, the Clinic ceased its work.

Such, then, are a few of the highlights of the progress in exercise physiology during the past two years. I wish I could list a few clear and simple ways in which they could vitalize your relations with the college women whose exercise programs you administer and supervise. A theoretical training in your profession and an acadamic interest in its problems is not enough to enable one to do this. By themselves such appreciations are sterile. They need the eager and inquisitive interest of the teacher whose heart and hands are devoted to the solution of the varied problems of physical education to make them seem practical and real. In my review of the recent growth in applied physiology I was struck by the fact that although the physical education profession owes its very existence to exercise, it is taking almost no part in the evolution of its physiology. The experimental biologist is carrying the major burden. Probably rightly so. America's contribution to exercise physiology, strictly defined, is relatively meagre. We have few centers of exercise research in this country besides Dill's Fatigue Laboratory at

Harvard and the recently organized Laboratory of Physiological Hygiene at Minnesota being administered by Keys, a former student of Dill's. A second Fatigue Laboratory man, Robinson, former Olympic runner and track coach, has also commenced exercise research at Indiana University. We in this country have no broad, centralized organizations like the *Kaiser Wilhelm Institute für Arbeitsphysiologie* or the Kharkov Institute for the Study of Labor. Nor does our physical education association have anything comparable to the Medical Research Division of the Czechoslovak Sokol Union which contributes consistently to the understanding of exercise problems through research. Hodgson, at the University of California, is organizing a laboratory like our own, devoting itself specifically to the study of the exercise of women. Perhaps American science is not more interested because American physical education does not care. Why is it, Steinhaus has asked, that the anatomist, the histologist, physiologist, biochemist, biophysicist have flirted with physical education, helped her discover herself, courted her for a short time and then left her just as things seemed serious? Did physical education, in her ignorance, perhaps show too little appreciation? Did her interest in education cause her to disregard and thus lose these promising friends? Steinhaus believes that one of the major obstacles confronting physical education today is a shortage of true scholarship. We are short on *time*, and *space*, and *facilities* for academic things. Our research committees elaborate complex schemes of gathering together lists of researches which might be applied to the solution of physical education problems. Research comes from within. It is creative. No priming with checklists can make it flower. What physical education does need is a few more practising physical educators with a doctor of philosophy in chemistry, or physics, or anatomy, or biology. . . . working in environments where leisure for thought is not considered time wasted, where 40 or 50 per cent of the teaching load is devoted to research as it is in other departments of the University, where funds are available for instruments of precision and technical assistants. We have been contented to remain too close to the surface of things. I do not believe I could end better than by reading the inspirational wishes Pavlow left to the academic youth of his country only a few weeks before his death at the age of 87 and less than 6 months after the biological scientists of the world had gathered at his feet in one of the magnificent palaces of Leningrad, and given him one of the most stirring ovations I have ever witnessed. These three wishes are beautifully written, almost in Biblical language. They have, I am quite sure, a universal application to every individual who counts himself a University teacher, irrespective of his special field.

What can I wish to the youth of my country who devote themselves to science?

Firstly, gradualness. About this most important condition of fruitful scientific work I never can speak without emotion. Gradualness, gradualness, and gradualness. From the very beginning of your work, school yourselves to severe gradualness in the accumulation of knowledge.

Learn the ABC of science before you try to ascend to its summit. Never begin the subsequent without mastering the preceding. Never attempt to screen an insufficiency of knowledge even by the most audacious surmise and hypothesis. Howsoever this soap-bubble will rejoice your eyes by its play, it inevitably will burst and you will have nothing except shame.

School yourselves to demureness and patience. Learn to inure yourselves to drudgery in science. Learn, compare, collect the facts!

Perfect as is the wing of a bird, it never could raise the bird up without resting on air. Facts are the air of a scientist. Without them you can never fly. Without them your "theories" are vain efforts.

But learning, experimenting, observing, try not to stay on the surface of the facts. Do not become the archivists of facts. Try to penetrate to the secret of their occurrence, persistently search for the laws which govern them.

Secondly, modesty. Never think that you already know all. However highly you are appraised, always have the courage to say of yourself, "I am ignorant."

Do not allow haughtiness to take you in possession. Due to that you will be obstinate where it is necessary to agree, you will refuse advice and friendly help, you will lose the standard of objectiveness.

Thirdly, passion. Remember that science demands from a man all his life. If you had two lives that would be not enough for you. Be passionate in your work and your searchings.

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A Study of Distances Traversed by College Men and Women in Playing the Game of Basketball

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DURING the 1939–40 school year a study was made of the distances traversed by men and women basketball players at DePauw University. Players included in this study participated on teams competing in the intramural athletic program promoted by the physical education department. All games were played on courts of the same size, 40′ x 70′, making possible a direct comparison of distances traversed per unit of playing time.

The measurement was made possible through the use of a pursuit apparatus which provides for numerical registration of unit distances traversed.[1] It consists of a metal floor, laid off to scale (four feet to the inch), wired in series with dry-cell batteries, an electric impulse counter, and a small brass tracing wheel four inches in circumference, insulated at half inch intervals on the circumference with adhesive tape. As the wheel is rolled over the surface of the metal floor, a series of makes and breaks in the electric circuit are produced, each one of which represents a distance of two feet on the playing floor. To determine the distance traversed by a player, the experimenter follows the movements of the player under observation with the small tracing wheel. Free throw lanes, center circle, etc., guide the experimenter in following the player.

Several games were clocked during the year, but the results of only twenty games, selected at random, are included in this study. Of the twenty games, ten are represented by men players and ten by women.

In the ten women's games the distances traversed ranged from 3,794 feet, traveled by a guard on a team using a zone defense, to 6,610 feet traveled by a forward, with an average for the ten players of 5,477 feet (1.03 miles). In the men's games the distances ranged from 7,720 feet to 14,218 feet, with an average of 11,502 (2.17 miles) for the ten players (see Table I). Since both men and women played on the same floor, in games consisting of four 8-minute quarters, a comparison by game totals is permissible. The women played under rules governing women's two-court basketball, while the men played under official men's rules.

While the present study deals with distances traversed by players on a court 40′ x 70′ in size, previous studies have dealt with distances

[1] Lloyd Messersmith and Stephen Corey, "The Distance Traversed by a Basketball Player," Res. Quart., 2:2 (May 1931).

traversed by players on larger courts.[2] Individuals playing on courts 50′ x 74′ in size have been found to travel approximately 2.40 miles per game (32 minutes of playing time) while individuals playing intercollegiate basketball on larger courts, 94′ x 50′ in size, have been found to travel approximately one mile farther per game, or about 3.50 miles for 40 minutes of playing time. Distances have been found to reach as high as 3.97 miles per game in college basketball.

TABLE I

Games	Men			Women		
	Total Distance		Feet per	Total Distance		Feet per
	Feet	Miles	Minute	Feet	Miles	Minute
1	12,270	2.32	383.1	5,640	1.06	176.2
2	10,450	1.97	226.5	6,254	1.18	195.4
3	13,080	2.47	408.8	5,270	1.00	164.7
4	9,196	1.74	287.3	5,023	.95	156.9
5	12,296	2.32	384.2	6,610	1.25	206.5
6	12,284	2.34	383.8	4,858	.92	151.8
7	14,218	2.69	444.3	5,544	1.05	173.2
8	12,490	2.36	390.3	3,794	.72	118.5
9	7,720	1.46	241.0	5,320	1.00	166.2
10	11,010	2.08	344.1	6,460	1.22	201.8

SUMMARY

1. The distance traversed by men for 32 minutes of playing time in basketball, on a 40′ x 70′ court, ranged from 1.46 to 2.69 miles, with an average of 2.17 miles for ten players.

2. The distance traversed by women for 32 minutes of playing time on a 40′ x 70′ court (women's two-court rules) ranged from .718 miles to 1.25 miles, with an average of 1.03 for the ten players.

3. The distance traversed by men was approximately twice that traversed by the women per unit of playing time.

4. The 40′ x 70′ court, used in this study, should be particularly applicable for use in intramural basketball because of its small size and the subsequent decrease in activity for players not trained to the high degree of perfection found in varsity athletes.

[2] Paul J. Fay and Lloyd L. Messersmith, "The Effect of Rule Changes Upon the Distance Traversed by Basketball Players," RES. QUART., 9:2 (May 1938).

Short Cuts in Working Out Intercorrelations

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BECAUSE many of us are not within reach (literally, financially, or both) of a Hollerith machine for doing correlations rapidly, a research which involves a large number of intercorrelations is apt to be appalling in its demand for time. However, there are several ways by which this time can be reduced and the work speeded along. This paper presents a number of short cuts which have been worked out personally and gleaned from helpful teachers and co-workers. The devices are not necessarily original but it is believed that they will be found advantageous in the computing of coefficients of correlation by the Pearson product-moment method.

1. If the data are recorded on 5″ x 7″ or 3″ x 5″ cards, they will be easier to handle. Cards do not wear out as soon as sheets of paper and they are easier to sort.

2. Allow extra room on the data cards for the two or more records which are necessary for the computing of reliabilities, room for T-scale scores, combinations, indices, and so forth.

3. The data should be recorded in ink, preferably indelible. Different colored cards or inks to indicate the sexes or other clearly defined groups will be of help in handling the data.

4. If the records are staggered instead of listed in straight columns, the reading of scores will be easier because each item stands out clearly and is easily picked up by the eye from its known position in the group. Figure I, dealing with strength and normal weight data, is an example of this plan.

Figure I. Strength and Normal Weight Data Card.

Name	Date ..... Height .....
Right grip	Weight ..... Age .....
Left grip	Chest girth .....
Push	C.g. corrected for fat .....
Pull	Hip width .....
Back lift	H.w. corrected for fat .....
Leg lift	Knee width .....
P.F.I.	Normal wgt. .....

5. Tabulate and check each of the variables to be correlated on a key sheet. On this key sheet work out the correction, the correction squared, sigma, standard deviation, and mean. If this is done and

checked, there will be no need to do this work on each of the scattergrams. The scattergram class intervals, guessed averages, and frequencies are copied from these sheets. The corrections and sigmas can then be worked out on this key sheet and recorded on the scattergram before the tabulations are entered. The sum of *fd* should also be recorded because it will be useful in a check for accuracy of a later computation (§13). It is possible to use the first scattergram of any variable as this key sheet. It has been found, however, that these extra key sheets are valuable in that the T-scales can be worked out on them, and the various computations are readily available on this set of key sheets.

6. If scores of time are involved, list the best score (the smallest interval of time) at the top or righthand end of the scale, so you will not be deceived by negative correlations.

7. List the correlations to be computed. The scattergrams can be checked against the list and the resulting *r*'s recorded on it.

8. The scattergrams are more easily read if the following suggestions are carried out.

a) Put the guessed average lines in color. Later put the deviations in color. This makes them stand out more clearly and simplifies the work. *Care should be taken to see that these guessed averages agree with those on the key sheet.*

b) Fill in the formula for *r* with the corrections and the sigmas. This eliminates extra handling and fills in the blanks of the formula with the exception of one figure (Figure II).

c) Copy the frequencies for both variables. This facilitates checking the tabulations and makes for less error (See Figure II).

d) Copy the sum of one of the *fd*'s, being sure to label it *fdy* or *fdx* (Figures II and V).

e) At this time it is well to do all the multiplications involved in the formula in Figure II. All the scattergrams of like items are together. All *A*'s are against the rest, etc., so multiplication can be speeded.

9. Before tabulating the scattergrams, sort the cards according to one variable by class intervals, *then check each pile and the frequencies in each pile with the key sheet.*

If you are working on a set of intercorrelations and you have been correlating variable *A* with *B-n*, you have the cards sorted according to *A*. Leave variable *B* for your last correlation. Then when you are ready for *B*, divide your piles of *A* across the table into columns of *B*. Then record each square, check, and gather the cards up by columns, *B*'s which you now correlate with the others, after checking again with the original tabulations of *B*.

10. If the cards have been sorted according to *A* class intervals, it is quite easy to tabulate several at a time, *AC, AD, AE, AF,* and *AG*. Place the scattergrams so that the class intervals of *A* are along a level

FIGURE II. A SCATTERGRAM READY FOR TABULATION

A (x) \ C (y)	10	20	30	40	50	60	70	80				
55									3			
50									6			
45									10			
40									15			
35									30			
30									32			
25									16			
20									17			
15									11			
10									5			
5									5			
	6	11	16	26	35	29	18	9	(150)			

$$r = \frac{\frac{Exy}{N} - 1 \times \underset{(cy)}{533} \cdot \underset{(cx)}{.0067}}{\underset{(6y)}{1.7577} \cdot \underset{(6x)}{2.2196}} \qquad r = \frac{}{3.9014}$$

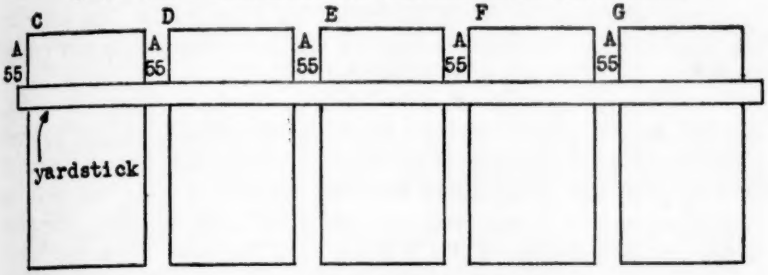
$$Efd = -23$$

line across all five sheets. If you are starting at the top, i.e., 55 on *A*, place a yardstick or strip of stiff cardboard just under 55. It helps to thumb-tack a paper with the class intervals for the variable for each sheet in the proper place on this yardstick. This prevents errors due to running the eye down a long column (Figure III).

The cards are dealt according to *A*, and the class intervals and frequencies of *A* are alike so you take the pile of those belonging to 55 in *A* and plot *B*, *C*, *D*, *E*, and *F*. You know the *row* is correct so you are concerned only in getting the tab into the correct *column*. When you have finished all of *A*, check all frequencies both ways, so that corrections may be made by dealing out one or more columns from the pile.

11. If you are doing a really large number of correlations it may

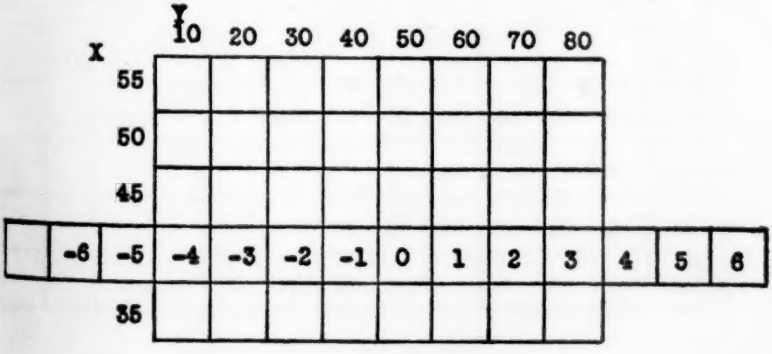
FIGURE III. ARRANGEMENT FOR TABULATING FIVE SCATTERGRAMS



save time to prepare a table of divisions of your most frequent range of numbers by N, the number of records you have. However, a slide rule can be used to advantage and if the rule is checked for accuracy and carefully read, the errors will usually be less than if a different set of class intervals had been chosen. Multiplications can be done with the aid of the multiplication tables of A. L. Crelle, *Rechtenfeln* (G. Reimer, Berlin), which give products up to 1000 x 1000. Those who have computing machines can use the reciprocal of the number and multiply instead of divide. If the slide rule is used, set the glass slide on the number by which you wish to divide, place the dividend *over* this number, and read *up* from 1 on the D scale for the answer.

12. When computing for the cross-products or product-moment values, it has been found that it pays to figure this for the columns, the deviations from the y guessed average, and also, for the rows, the deviations from the x guessed average. Then this sum of the cross-products column must equal the sum of the cross-products row (See Figures V, '511'). This takes a little longer but serves as a definite check on the accuracy of the work. If, however, the check suggested in §13 is used it will be unnecessary to compute both of the cross-products unless as a check only on multiplications. While doing this computation, it has been found that a slip of cardboard matched to the squares of the

FIGURE IV. AN AID IN COMPUTING CROSS-PRODUCTS VALUES



scattergram and marked with the deviations from the guessed average facilitates the work. This is illustrated by Figure IV. Beginning at the right of Figure IV and multiplying the frequency in the row represented by 45-49 we have the following:

$$(3\times1)+(2\times3)+(1\times8)-(1\times5)-(2\times1)-(3\times1)$$

and the result is 7. Multiplying 7 by the deviations of that row, 3, gives a cross-product of that row of 21. This slip under each row as the work is done gives the deviations so that the worker's eyes do not have to shift so often, and so that errors are less likely to occur. The same plan works for the columns. A slip is made to fit the side of each column.

13. If the sum of x is recorded as well as the sum of xy (See Figure

FIGURE V. SCATTERGRAM SHOWING TWO POSSIBLE CHECKS ON ACCURACY OF CROSS-PRODUCTS VALUES

X \ Y	10	20	30	40	50	60	70	80	f	d	x	x'y'	
55								3	3	5	9	45	
50							2	4	6	4	16	64	
45						1	7	2	10	3	21	63	
40					5	5	5		15	2	15	30	
35				5	12	9	4		30	1	12	12	
30				14	11	7			32		-7		
25				2	7	7			16	-1	5	-5	
20		5	7	5					17	-2	-34	68	
15		4	7						11	-3	-26	78	
10	1	2	2						5	-4	-14	76	
5	5								5	-5	-20	100	
f	6	11	16	26	35	29	18	9			-23	511	
d	-4	-3	-2	-1	1	2	3						
y	-29	-30	-43	-7	15	43	37						
x'y'	116	90	86	7		15	86	111	511				

Efdy = -23

V), and if the sum of x is computed also for the row of the guessed average, —7 in Figure V (for which the sum of xy is zero), the *sum* of this sum of x column (—23) must be identical with the sum of the fdy row. In Figure V the sum of the fdy row, —23, has been copied into the scattergram from the key sheet and is shown to be identical with the sum of x when x is also computed for the row of the guessed average, —23. This gives a useful check on the accuracy of the work and eliminates the necessity for computing the sum of xy for both rows and columns as suggested under §12.

14. Prepare an intercorrelation chart. It is easier to get the whole picture from such a chart. Besides, you will then have your results in three different places, your list to be done, your scattergrams themselves, and this intercorrelation chart. And it is well to keep them in separate places so that if something unforeseen happens to one set, you do not have to repeat all the work.

15. *Label everything* completely so that if a wind scrambles your papers, they will be readily identified—ten years later as well as when fresh.

Report on National Survey of Student Recreation in Colleges and Universities

By A. S. Daniels
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THIS national survey of student recreation was made in connection with a study of the situation at the University of Illinois. A faculty committee appointed with the sanction of President A. C. Willard is at the present time considering the problem. On this committee are represented the Colleges of Law, Commerce, Engineering, Agriculture, Fine and Applied Arts, Liberal Arts and Sciences, and the School of Physical Education. The purpose of the national survey was to secure data for comparative purposes.

THE PROBLEM DEFINED

This study is largely motivated by the fact that leisure and its uses is one of the most pressing problems thrust upon the American people today by swiftly moving social and economic developments.

Furthermore, it is felt that the great responsibility of educating for what is now known as leisure does not belong in the hands of casual agencies but rests with our great agencies for deliberate education: the school, the college, and the university. There is reason to believe that while many of our institutions of higher learning are doing "something" along these lines by providing opportunities for self-expression and development through extracurricular activities, they lack a coordinated plan and have little or no way of ascertaining the extent to which these offerings meet the needs of the student body. Though the regular curriculum may be designed with great care, the so-called extracurriculum represents a haphazard, unplanned, and uncoordinated conglomeration of activities inserted into the school calendar.

A NEW NEED

Ample justification for a consideration of the problem of recreation may be found in the latest and most authoritative literature in the field of education, as well as in a direct study of conditions found on many college campuses throughout the country. Rooted firmly in the philosophy of modern education is the thought that the total organism must be given the opportunity for experiences of an all-round nature, with these experiences based on the social and biological needs which will enable an individual to live most successfully in relation to his particular social group.

Acceptance of this philosophy implies the responsibility of devising ways and means whereby its stated purposes may be achieved. By no manner of reasoning can such purposes be realized without due consideration of, and provision for, opportunities in a wide range of recreational activities, such as crafts, music, nature, dramatics, sports and games, etc. Furthermore, these opportunities must be made available to all students and not merely the most talented and highly trained.

A study of the development and present status of intercollegiate and intramural athletics and extracurricular activities in general indicates a need for a planned and coordinated program of recreation. Intercollegiate and intramural programs had as their main purpose at the time of their inception, satisfaction of the recreational needs of the student body. The intercollegiate program had its beginning in the friendly and informal play of small groups of students. As play developed, it underwent increasing organization; from informal play to competition among organized groups, to interclass competition and eventually interschool games.

As interschool games became more highly organized, it became apparent that only students capable of a high level of performance could find an outlet for their ability in this program. Little was done about this situation until about 1911 when it was felt that if organized athletics were good enough for some, why should they not be good enough for all, or at least as many as chose to take part. From that time on, intramural athletics have advanced rapidly, not only in organization, but also in quality of performance, until today we find almost the same situation in regard to intramurals as was found earlier in the case of intercollegiate athletics. The quality of performance is so high and the desire for group prestige resulting from the winning of championships and trophies so great that in many schools only those students who will definitely contribute to the chances of having a winning team are permitted to play for the group. In some competitive units (fraternities particularly) this means that anywhere up to 50 per cent of the members may be denied the opportunity to compete.

This brief review of athletic history suggests that we may have to create still another type of program wherein students of all levels of ability will have opportunity for participation.

OTHER ASPECTS OF THE PROBLEM

To observers of student activities in institutions of higher education it is readily apparent that this situation is not confined to the area of sports. Most extracurricular activities are organized and promoted in such a manner that definite and developed talent is required for participation. This is true of touring *a cappella* choirs, glee clubs, dramatic clubs, and debate teams where standards of performance are so high that those of limited ability are given little or no consideration.

While it is agreed that high quality performance in itself merits no

objection, criticism may be voiced when levels are so high that large numbers are denied the privilege of desirable experience. Conditions such as these send ordinary students up into the stands while those of superior ability play the games, sing in concerts, and debate for the school. These talented groups should be continued, of course; but more adequate provision might well be made for that large number of individuals who possess only ordinary ability and skill. The point being made here is that the school has a responsibility for the fullest development of *all* individuals and not only the most gifted. This is one of the basic premises of democratic education.

PURPOSE AND SCOPE OF ILLINOIS STUDY

The purpose of this study is to consider recreational needs in relation to student life. The form of the study is as follows:

1. To make a survey of student recreation programs in colleges and universities throughout the United States.

2. To make a thorough study of the status of student recreation on the campus of the University of Illinois and immediate environs. This study to include:

a.) Individual practices, interests, and problems in regard to recreational activities engaged in during the school year.

b.) Fraternities and sororities and organized houses in regard to recreational programs and problems.

c.) Student-controlled, extracurricular, leisure-time organizations on campus to determine the nature and extent of recreational activities in their general programs.

d.) Churches, Y.M.C.A., Y.W.C.A., and Student Union to determine the nature and extent of recreational programs offered in these institutions.

e.) Commercialized recreation in campus environs to determine the number of commercial establishments, and the nature of their attractions and approximate extent of student patronage.

f.) Outdoor recreation areas within a radius of five miles of campus.

3. To make an analysis of these findings.

4. To draw conclusions based on these findings.

5. To make recommendations to the university authorities designed to:

a.) Provide for specific leadership and a coordinated but decentralized plan for the administration of student and faculty recreation.

b.) Increase recreational facilities and thereby broaden the opportunities for participation by all students in a wide range of activities.

c.) Influence attitudes and raise standards of practices in regard to uses of leisure on the part of present students and future alumni.

PROCEDURE

The four-page printed questionnaire was sent to 700 selected universities, colleges, and normal schools in the United States and possessions. The following material is a report of the findings, interpretations, and conclusions of the first part of the study (the national survey of student recreation in colleges and universities).

Information on the practices, problems, policies and plans of organization from forty-eight states, Alaska, and Puerto Rico are represented in the summaries.

1.*	Number of questionnaires sent	700	Per Cent
	Number of institutions replying	410	59
	a.) Universities	101	25
	b.) Liberal Arts and Science colleges	191	46
	c.) Normal and teachers colleges	118	29

TABULATIONS AND INTERPRETATIONS OF DATA

II. Facilities†

1. Please check the facilities available to students for general student recreation. Include those for both men and women in your notations. (See Table I.)

In only a few instances were sketch clubs, painting groups, etc., listed as student opportunities.

Owing to the many different types of halls and rooms available, social dancing is probably the one activity for which adequate facilities are found in most institutions. The frequency with which dances are held would also indicate that this activity comes as close as any in the college recreation program to satisfying student desires for a particular activity. Some schools have made considerable advances in broadening student dance interests by introducing folk, country, and other types of dancing into the program.

Most institutions have some facilities available for dramatics. The range is from completely equipped little theaters to auditoriums, portable stages, and rooms merely equipped with raised platforms.

The majority of handcraft facilities were indicated to be used largely in connection with scheduled class work. Hobby groups and informal use of the facilities exist only to a small degree. Illustrative of the latter type of usage are Purdue's "puttering room" in the student union and the practice of M.I.T. students in using the fine resources of that institution for such hobbies as model engine making, etc.

The few types of clubs listed under hobbies is indicative of a lack of activity in this area. Despite the fact that hobbies should be, and give

* The numbering of the paragraphs corresponds to the numbering of items in the questionnaire.

† The facilities checked in the individual returns represent in the majority of cases the total recreational potentialities of the institution. Evidence of this is shown in the numerous instances where the questionnaire was passed around to the various departments for checking.

most satisfaction as, a personal sort of a thing, the development of hobby interests can be encouraged by schools in many ways without stifling individual initiative by "over-organization." Favorable attitudes toward hobbies and the provision of facilities for their practice are two possible contributions the college can make.

The majority of facilities noted under "music" in Table I are either for class work or for organized talented groups. Music facilities were shown to be available for evening use in only 4 per cent of the cases.

Two hundred and thirty-four picnic grounds were listed by 366 schools. Second on the list of outing facilities were cabins (123). Cars are not considered in this comment because in most instances their primary purpose is not for outings. Developed trails (hiking and ski) ranked fourth with 117.

TABLE I

Type of Facility	Rank	Available		Owned by School	
		No.	Per Cent	No.	Per Cent
Arts—painting, drawing, sculpturing (368 replies)					
Studio	1	202	55	196	97
Rooms	2	140	38	128	91
Others: Commercial art					
Dancing (396 replies)					
Gymnasia	1	320	80	311	97
Social halls	2	287	72	260	91
Others: Modern dance studio, sorority rooms, residence halls, fraternity parlors.					
Dramatics (403 replies)					
Indoor theater	1	324	80	318	95
Outdoor theater	2	101	25	101	100
Others: Auditorium, portable stage.					
Handcrafts (337 replies)					
Woodwork	1	153	45	122	79
Costume design	2	147	43	105	72
Metal work	3	145	43	107	73
Leather work	4	110	32	76	69
Weaving	5	108	32	74	68
Pottery	6	101	29	69	68
Etching	7	96	28	67	69
Knitting	8	69	20	43	62
Others: Textile printing, jewelry making.					
Hobby Clubs (359 replies)					
Photography dark room	1	231	64	225	97
Museums: natural history	2	188	52	165	82
art	3	124	34	98	79
Others: Observatory, rifle club, press club					

Type of Facility	Rank	Available		Owned by School	
		No.	Per Cent	No.	Per Cent
Music (401 replies)					
Glee club room	1	319	79	312	97
Equipment: instruments	2	286	71	265	92
records	3	267	64	256	93
library	4	245	61	228	93
Studio (composing, appreciation)	5	223	55	216	96
Outing Activities (366 replies)					
Picnic grounds	1	234	63	110	47
Cars	2	149	40	65	43
Cabins	3	123	33	59	47
Trails	4	117	32	36	30
Camps	5	84	22	25	29
Lodges	6	69	18	32	46
Field stations (biology, geology)	7	66	18	37	56
Others: Equestrian trails, recreational parks					
Sports (301 replies)					
Fields					
Softball	1	271	90	262	96
Baseball	2	255	84	173	68
Football	3	248	82	227	91
Field hockey	4	186	61	180	96
Soccer	5	185	61	158	85
General recreation	6	178	59	125	70
Lacrosse	7	36	11	26	72
Pony polo	8	15	5	9	60
Courts					
Basketball	1	300	100	295	98
Tennis	2	293	97	266	90
Volleyball	3	261	87	252	97
Horseshoes	4	252	83	228	90
Handball	5				
Single		150 } 233	50 } 77	137	91
Four-wall		83 }	27 }	75	90
Badminton	6	232	77	109	47
Shuffleboard	7	176	58	160	90
Deck tennis	8	136	45	121	88
Paddle tennis	9	133	44	108	81
Squash	10	55	18	42	76
General					
Archery range	1				
Indoor		92 } 299	30 } 95	69	75
Outdoor		207 }	65 }	187	90
Pools*	2				
Indoor		252 } 367	61 } 89	201	79
Outdoor		115 }	28 }	38	33
Track	3	244	81	252	84
Golf course	4	231	77	52	24
Gymnastics	5	229	76	184	80
Bowling alleys	6	193	64	48	24
Horseback riding	7	183	60	29	15
Fencing	8	178	58	128	71

Type of Facility	Rank	Available		Owned by School	
		No.	Per Cent	No.	Per Cent
Wrestling	9	177	58	151	85
Boxing	10	149	49	45	30
Rifle range	11				
Indoor		96 } 144	31 } 47	59	61
Outdoor		48 }	16 }	35	72
Natural bodies of water*	12	189	46	34	18
Weight lifting	13	89	29	64	71
Ice hockey rink	14	83	27	35	42
Ski jumps	15	58	19	12	20
Pistol shooting	16	52	17	30	57
Boathouse*	17	62	15	28	45
Others: Casting pool, driving range, Rugby field, putting green					
Social Recreation (301 replies)					
Small active game equipment	1	211	70	53	25
Reading	2	211	70	24	11
Quiet game equipment	3	192	63	21	11
Others: Social unit, pool, movies, lounge					

* Based on 408 replies.

A glance at the data on sports facilities might seem at first to give the impression they are adequate because the percentage of availability is higher than in other recreational areas. For the basic types of fields and courts, however, such as, softball, football, general recreation, basketball, tennis, handball, badminton, etc., adequacy is hardly possible unless the figures showed 100 per cent availability.

A factor which distorts the picture somewhat is the multiple use of fields in some institutions. In these cases the same field might be listed under softball, football, and general recreation.

In the area of general sports facilities, archery ranked first in availability, track second, and golf third. A factor noteworthy because of its effect on participation is that 256 of the 299 archery ranges were owned by the schools, whereas only 52 of 231 golf courses showed school ownership. In the latter case fees and transportation would tend to restrict golfing activity.

Only 70 per cent answering the question on "Social Recreation" indicated that equipment for small active games (table tennis, etc.) was available in social halls. The data concerning reading facilities also showed 70 per cent availability. Quiet games (checkers, etc.) ranged third with 63 per cent.

2. *Are the majority of your facilities available to individuals and unorganized groups?* (301 replies)

Yes	Per Cent	No	Per Cent
266	88	35	11

The majority of answers showed that individual students and unorganized groups had access to most facilities. The data do not show the extent to which participation is encouraged or promoted.

3. Which major facilities are available for general evening use? (301 replies)

Facility	Rank	Frequency	Per Cent
Gymnasium	1	100	33
Social halls	2	83	27
Sports	3	64	21
Library	4	43	14
Swimming pool	5	27	9
Dancing	6	26	9
Dramatics	7	26	9
Games	8	21	7
Music	9	13	4
Clubs	10	12	4
Theater	11	5	2
Fields	12	5	2

Facilities for sports and games (gymnasium, etc.) and social recreation lead the list of facilities available evenings. In no case is the percentage very high. Social halls, ranking second, show availability in only 27 per cent of the cases.

4. Do you contemplate extending your recreational program? (301 answers)

Yes	Per Cent	No	Per Cent
190	63	96	31

Area	Rank	Frequency	Per Cent
Sports and games	1	80	27
Social recreation	2	58	19
Fields*	3	31	10
Outing activities, camping	4	23	7
Undetermined	5	19	6
Swimming	6	18	6
Gymnasium		18	6
Athletics equipment		18	6
Educational opportunities		18	6
Intramural athletics	10	13	4
New buildings	11	12	4
Union activities	12	8	2
Coordinating activities	13	7	2
Track	14	4	1
Hobby groups		4	1

* Considered as part of sports expansion program.

Sixty-three per cent of the schools are planning on expanding the recreational program. In this contemplated expansion, sports and games, social recreation, and outing activities rank as the first three. Sports and social recreation, ever popular, lead as might be expected. Interest in outing activities shows a gratifying growth and is in all probability a direct reflection of the increased public participation in this attractive and beneficial form of recreation.

Intention of providing hobby opportunities ranks last on the expansion program.

5. Is college-owned equipment loaned for general recreational use? (301 replies)

Yes	Per Cent	No	Per Cent
234	77	67	22

Equipment loaned	Rank	Frequency	Per Cent	No Charge	Per Cent	Charge	Per Cent
Balls (all types)	1	200	66	178	85	8	4
Archery tackle	2	134	44	121	90	7	5
Shuffleboard	3	132	43	105	80	5	4
Musical instruments	4	116	35	92	79	6	5
Movie projector	5	115	34	94	80	9	8
Racquets	6	94	31	79	79	8	8
Golf clubs	7	46	15	37	75	4	9
Handcraft	8	43	14	34	80	8	20
Camping	9	40	13	18	45	5	12
Skis	10	32	10	23	72	2	7
Toboggans	11	27	9	17	63	4	2
Picnic kits	12	26	8	23	88	3	11
Canoes	13	19	6	15	80	4	20
Bicycles	14	9	3	3	33	6	66

Others: Swim suits, fencing, badminton, boxing gloves, sleds, skates, croquet, snowshoes, lawn bowls, lacrosse, rental pictures, bowling, horseshoes, paddle tennis.

College-owned equipment is loaned for general use in 234 schools (77 per cent). Balls, archery tackle, and shuffleboard equipment lead the list.

Fees are charged in only a few cases. The items for which charges were most commonly made were bicycles, canoes, craft materials, picnic

III. Special Programs

1. List any special events of a recreational nature held during the year. (401 replies)

Event	Rank	Frequency	Per Cent of Total Answers
Demonstrations—sports, etc.	1	277	67
Class picnics	2	268	65
Lectures and concerts	3	265	64
Lectures—recreational topics	4	256	62
May Day	5	198	48
Recitals—music, dance	6	189	46
Water carnival	7	144	35
Coeducational swimming	8	142	35
Student hobby exhibits	9	132	33
Interfraternity sing	10	128	32
Mountain day	11	43 2172	10

Others: Horse show, mardi gras, band festival, playday for women, forest festival, arbor day, campus day, field day, President's day, rodeo, monogram day, variety show, student art exhibit, science show, freshman week social, bridge tournaments, religious programs, red bud festival, ice carnival, circus, round-table discussions on current topics, coed sports day, cotton pageant, Christmas festival.

and camping kits. Bicycles, canoes, and craft materials showed the highest incidence of fees.

In the area of special programs, 34 different types of programs were listed a total of 2,172 times. Sports demonstrations, class picnics, and lectures and concerts were most popular. The "doing" type of activities outnumbered the "passive" 7 to 4 in the 11 programs most frequently listed.

IV. Problems

1. List undesirable types of commercial amusement in close proximity to the campus; in campus environs, or easy traveling distance.

Commercial recreation listed as a problem (405 replies):

Yes	Per Cent	No	Per Cent
233	58	172	42

Type of Commercial Recreation Listed as a Problem	Rank	Frequency
Dance halls	1	55
Taverns	2	53
Roadhouses	3	47
Pool halls	4	45
Night clubs	5	38
Gambling	6	18
Motion pictures	7	17
Roller skating	8	8
Bowling alleys	9	7
Amusement parks	10	4
Bathing beaches	11	2
Wrestling matches (women's)	12	2
Cocktail bars	13	2

Others: Prize fighting, Sunday baseball, skating rink, burlesque, flying, smoke shops, night baseball for women.

Data from 233 schools (58 per cent) classed some form of commercial recreation as a problem. Twenty-two types were listed a total of 300 times. Four of the 22 containing common elements (dance halls, taverns, roadhouses, and night clubs) constituted 64 per cent of the total.

An accurate picture of the relation of commercialized recreation to all the schools supporting the study is not possible because in a number of instances reports from large universities situated in metropolitan districts merely read, "the usual problems of commercialized recreation in a large city."

2. Do you feel that existing organizations, such as drama club, glee club, debate, intramural athletics, etc., provide sufficient opportunity for students of limited ability?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
398	97	246	61	152	39

While 61 per cent of the respondents answered this question in the affirmative, 39 per cent of the schools reported that extracurricular organizations were not providing for students of limited ability.

3. Are unofficial but affiliated organizations, such as churches, Y.M.C.A., Y.W.C.A., etc., carrying part of the responsibility for student recreation?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
395	96	278	70	117	30

Amount:

All	Per Cent	Great Deal	Per Cent	Very Little	Per Cent
2	.005	79	20	185	46

The most common situation found on campuses was that churches, etc., were carrying "very little" of the student recreational program.

4. As an administrator do you feel that the student of limited ability and undefined interests in your school has adequate outlets for self-expression and development through a wide range of recreational activities?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
395	96	218	55	177	44

Forty-four per cent of the schools (177) replying admitted that the type of students mentioned above did not have adequate opportunities for recreational outlets. The attitude of some schools was expressed as follows: "We provide the opportunities and it's up to the students" etc. Others expressed some concern over this situation and reported that steps were under way to provide remedies.

5. Do you feel that there is a need for a definite plan of guidance (leisure education) for students who are seeking or are unacquainted with worthwhile uses of leisure?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
388	94	324	83	64	16

Eighty-three per cent of the 388 replies to this question expressed the feeling that there was a need for some form of leisure education. Expressing it another way, it might be said that a large majority of administrators feel that the function of education should be broadened so as to take in *all* of living instead of just a segment of it.

V. Organization

1. Do you have a comprehensive and coordinated plan for general recreation which is designed to reach all, or at least a majority of the students?

Replies	Per Cent	Yes	Per Cent	No	Per Cent	Think So	Per Cent
410	100	269	69	121	30	20	5

The replies to this question would lead to a belief that in a majority of schools (69 per cent) comprehensive and coordinated programs were in existence. One important factor tends to offset this impression. This is the summary of answers to the third question in this section where 301 schools (73 per cent) state that a coordinated plan has never been tried. It is quite probable that those answering this question felt that a program of intramural athletics, and the usual drama, glee, and debate clubs, plus a few isolated events, constituted a comprehensive and coordinated program. As was stated earlier, a program of this type would hardly suit as an answer to this question due to the large numbers of students unable to participate because of the high standards of performance necessary for membership in these groups.

2. If so, do you have a central plan of administration?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
394	96	214	52	196	48

In slightly more than 50 per cent of the cases, some central plan of administration is in vogue.

2a. Central plan administered by: (200 replies)

	Frequency	Per Cent
1. Director of Physical Education	86	43
2. Social Committee	82	41
3. Deans	32	16

Where some central plan was reported to be in operation the responsibility for its administration lay with two primary groups—directors of physical education and social committees. In 16 per cent of the cases the plan was supervised by one of the deans.

3. Has a coordinated plan ever been tried in your institution?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
410	100	109	27	301	73

See answers and comment to question 1, part V. There is good reason to believe that the answers to this part (3) represent a more accurate picture of the situation on most of our college campuses today.

4. Is student recreation obtainable mainly through independent units such as a drama club, glee club, outing club, etc.?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
410	100	294	70	106	30

In the majority of cases (70 per cent), student recreation was obtainable mainly through the units mentioned above.

VI. General

1. Would you be interested in the results of this study?

Replies	Per Cent	Yes	Per Cent	No	Per Cent
392	96	384	98	8	2

The 98 per cent who signified a desire for the results of this study show a widespread interest in the problem. Many, instead of using the check to indicate their desire for the results, wrote in the space provided "very much so."

2. Titles of persons signing questionnaires. (400 signatures)

Title	Rank	Frequency	Per Cent
Director of Health and Physical Education	1	106	25
President	2	81	19
Dean of College	3	52	12
Dean of Men	4	32	8
Director of Athletics	5	25	6
Professor	6	25	6
Dean of Women	7	16	4
Student Counselor	8	14	3
Secretary to President	9	14	3
Registrar	10	14	3
Instructor of Health and Physical Education	11	10	2
Assistant to President	12	9	2

Officers of the Administration	Frequency	Per Cent
President	81	19
Dean of College	52	12
Dean of Men	32	8
Dean of Women	16	4
Secretary to President	14	3
Registrar	14	3
Assistant to President	9	2
	218	51

Twelve types of positions were represented in the 400 signatures on the questionnaires. Signatures of officers of the administration far outnumbered any other group, comprising 51 per cent of the total. Directors of Health and Physical Education were next with 25 per cent of the total. Ten were unsigned.

CONCLUSIONS

1. While the recreational potentialities of the majority of institutions appear to be adequate to meet the needs of students in a wide range of activities, many useful facilities, such as shops, studios, etc., are available only to regularly scheduled classes. There appears to be need for a workable plan whereby student recreational outlets may be expanded and access gained to the valuable facilities which at the present time are restricted to a small number of students.

2. Interest in outing activities is growing. Facilities available and plans for extending the program indicate this. It is estimated that there are from 75 to 100 college outing clubs in existence.[1] Though largely centered in the east, they may be found in most sections of the country.

[1] A. S. Daniels, "College and University Outing Clubs," *Journal of Health and Physical Education*, 9:5 (May 1938) 278–81.

Approximately forty such clubs are members of the Intercollegiate Outing Club Association. The recent tremendous expansion of facilities in this field and the possibilities of this type of activity as one of enduring interest and great benefit warrant still greater exploitation in colleges.

3. The traditional competitive sports like football, baseball, and basketball are sharing the spotlight of interest with the so-called recreational sports. Archery, handball, softball, tennis, badminton, horseshoes, etc., are growing in popularity. This is evidenced in the increase in facilities and the extent to which college-owned equipment is borrowed by students for these sports. Toogood's study also indicates this in the case of college women.[2]

4. In at least two areas there is manifest a correlation between student recreational interests and those of the general public. The first is in outdoor recreation, and the second is in recreational sports and games.[3] Although public interest in a third is quite well established, the field of hobbies, there is no way of comparing the extent of student interest because in only a few institutions have provisions been made for determining and meeting needs in this area. Hobbies represent the "forgotten area" in college programs.

5. Encouragement of hobby interests should receive a larger share of attention in college programs because through a well-chosen hobby the student may find a method of expressing his innermost desires. Through the cultivation of a hobby the student develops within himself the means of self-expression and satisfaction of his needs. By becoming self-reliant, and to a degree self-sufficient, he achieves a certain measure of independence. His recreation may then go on when there are no companions to help solve his problems and no director to tell him what to do, when to do it and how it should be done. In a sense, the acquisition and practice of hobby interests come closer to being real education than many other aspects of the college program.

6. More equipment of the small active and quiet game type added to college social halls would possibly attract a greater number of recreation-seeking students to these desirable places.

7. The small number of schools attempting to provide evening recreation shows that either the idea has not yet met with general acceptance or that it has failed to impress as a need. Gymnasia and social halls might be kept open in a greater number of schools, at least two or three evenings a week. The question of week-end recreation in small college communities also arises.

8. Many school officials are cognizant of the need for greater attention to student recreational outlets. In almost two-thirds of the institutions cooperating in this study, plans are being made to expand the program in one or more of thirteen different areas.

[2] Ruth Toogood, "A Survey of Recreational Interests and Pursuits of College Women," RES. QUART., 10:3 (October 1939) 100.

[3] S. C. Staley, *Sports Education* (New York: A. S. Barnes and Co., 1939) 306–13.

9. The practice of loaning college-owned equipment to students is quite general. This policy is followed in slightly more than three-fourths of the schools supplying information in answer to this question. The policy of charging a rental fee is followed in only a very small percentage of the cases.

10. The area of special programs showed considerable diversity. In the eleven types of programs most frequently listed the "doing" kind outnumbered the "spectator" type seven to four.

A great deal has been written about "spectatoritus." It is quite possible that these warnings have been overdone. The role of the spectator and direct participation are both important to the total recreational experiences of the individual. Each type supplements the other. Attending the theater and concert are highly regarded and yet both are spectator types of activity. Watching a well-played athletic contest may be equally beneficial and yet it is regarded as a form of "spectatoritus" and not encouraged.

School administrators might well encourage both types—active and passive—with some attention paid to aiding each individual in learning what for him is the best balance.

11. Certain types of commercialized recreation were considered a problem in more than half of the institutions reporting. It is interesting to note that 64 per cent of the problem notations were grouped around 4 types although 22 were listed.

In planning to offset the attraction of undesirable commercial amusements, it should be evident that something more than legislation and dignified verbal and literary attacks is needed before progress along this front can be recorded. Many of our young people want adventure, thrills, and a challenge in their recreation. The naive faith that the good will ultimately triumph and needs no promotion has led to a complacency and a policy of inactivity on the part of many school officials. The good must also be made attractive and challenging. Virile programs, wide in scope and involving student participation in planning and executing, must be substituted for most legislation and "hopeful waiting." Application of accepted educational philosophy would preclude a majority of the present attempts at controlling undesirable types of commercialized recreation.

12. The survey definitely shows the need for a new type of program which does not put a premium on developed talent, high standards of performance, and unusual combinations of skills. We already have this kind of a program, and that it should be retained there is no question. There is, however, strongly indicated a need for a kind of program in which the majority of students may participate regardless of talent or previous training. The percentage of students not being reached reveals a definite need for increasing the range and rescaling the standards of performance in order to provide opportunities for those of ordinary ability.

13. There is general accord in the feeling that a need exists in colleges and universities for some form of leisure education. Dr. W. G. Carr, Executive Secretary of the Education Policies Commission, expresses the feeling of many when he writes concerning uses of leisure and leisure education: "None of these matters is unworthy of serious consideration by schools which are honestly concerned with the democratic ideal of helping each individual grow in self-realization. These are extracurricular in name only; indeed it is to be doubted whether any elements of the 'regular' curriculum are more truly educative than the activities associated with recreation. A shallow respect for false and harmful 'standards' has in the past kept the recreative arts in the place of the poor relation. It is time to place them in a position of honor at the educational table." [4]

Education for leisure might best be accomplished through a careful blending of deliberate effort on the part of school administrators and the many experiences possible in college and university life. The result of this blending would be an acquaintance on the part of the student, ".... with the fields in which the finer opportunities exist; the skills in games, the beauties of nature, the finer skills in the arts and crafts, and the real enjoyments of music and literature. The student should then be trained as an all-round man, a good judge of values, capable of doing his own choosing and developing his own techniques." [5]

14. In the majority of schools a coordinated plan aimed at fullest use of the recreational potentialities has never been tried. Such a plan would give an opportunity to check and see what is going on in our far-flung and loosely strung together extracurriculum. The time is appropriate to inaugurate efforts aimed at evaluation, control, and direction of this phase of the college program with its tremendous educational possibilities. Studies of student interests, desires, practices, and problems as they pertain to recreation might profitably be undertaken in many schools.

15. The large number of institutions cooperating in the study and the practically unanimous requests for the results show the matter of general student recreation as ranking high in the interests of administrators. The summaries represent the situations and opinions from forty-eight states, the District of Columbia, Alaska, Philippine Islands, and Puerto Rico.[6]

[4] W. G. Carr, *The Purpose of Education in American Democracy* (Washington, D.C.: Educational Policies Commission, 1938) 67.

[5] A. S. Daniels, "The Responsibility of the College in Educating for Leisure," *School and Society*, 41:1065 (May 25, 1935) 706–7.

[6] Another indication was the highly successful state conference held on this topic at the University of Illinois last November. Approximately 200 Illinois college and university instructors and coaches, representing more than 80 per cent of the eligible personnel, were in attendance. The conference voted unanimously to meet again in 1940. This year the personnel will be expanded to include the departmnts of art, music, dramatics, literature, and sociology. Administrative officers are also to be invited. A limited number of copies of the conference proceedings are available. These may be procured by writing to Dr. S. C. Staley, School of Physical Education, University of Illinois, Urbana. A report of the conference findings was made by C. D. Giauque in the March, 1940, issue of the *Journal of Health and Physical Education.*

16. The number of departments which contributed information in the individual questionnaires, the range of fields (dramatics, music, art, etc.) involved in a comprehensive program, and proven administrative interest show this matter to be one which concerns the whole institution and not just a single department. The department of health, physical education, and recreation because of its traditional position might well take the initiative in instituting measures for getting a general program established. However, its organization and administration would properly include the deans, the departments involved, and student representation, all working on a harmonious basis.

The results of this survey permit two predictions. The first is that in the next few years there will be increasing acceptance of the idea of providing general student recreation as a legitimate college function, not as an effort to entertain but designed to increase the possibilities of fuller, richer living during school years and after. The second is that as a result of this acceptance the field will undergo considerable growth and expansion.

University of Illinois Committee for the Study:
V. E. Ferrall, College of Law
C. A. Moyer, College of Commerce
Albert Jorgensen, College of Engineering
D. E. Lindstrom, College of Agriculture
C. G. Schaffer, College of Fine and Applied Arts
N. E. Stevens, College of Liberal Arts and Sciences
A. S. Daniels, School of Physical Education, Chairman.

Chest–Height–Weight Tables for College Women

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IT IS rather generally agreed that the traditional age-height-weight tables are of little value in attempting to determine the so-called "normal" body weight of college women, and yet these tables continue to be used, chiefly because of their simplicity. The more effective methods of weight prediction which have been proposed from time to time have not been widely adopted because of real or imagined difficulties in making the necessary measurements and calculations. The method here reported has about twice the predictive efficiency of the age-height-weight tables and requires very little additional labor.

The basic data from which the Wellesley weight prediction table was developed were very generously supplied by nineteen colleges throughout the United States—four in the eastern district, eight in the midwest and central districts, three in the southern district, and four in the far west. The items studied were age, height, weight, chest depth, chest width, and hip width. All the 1,780 subjects were considered by the medical examiners to be in a state of excellent health and normal nutrition. Some of the subjects in each college were measured a second time in order to provide a means of checking on the reliability of measurement.

Out of the 1,780 cases, 1,580 were chosen for the final statistical study. Two groups of subjects were omitted because of apparent unreliability in measurement. Individuals were eliminated if they were under sixteen or over twenty years of age. A few cases were eliminated because of the presence of excessive fatty tissue (noted by the examiner on the data sheets) or because of extremes in any one measurement when this one was compared with other measurements of the same individual. The remaining 1,580 cases constituted an unusually "good" sample of college freshmen — adequate in numbers, widely distributed geographically, reliably measured, and normal with respect to health and nutrition.

After studying the selected data by means of statistical methods, the factors of height, chest depth, and chest width are recommended for use in predicting body weight. The height in inches is measured to the nearest half inch, the chest diameters to the nearest half centimeter. The chest depth is the horizontal distance between the mid-sternal and mid-spinal lines at the level of the lower end of the sternum; the chest

width is the horizontal mid-axillary distance at the same level. The subject stands reasonably erect and breathes naturally. Readings are taken at the end of a normal expiration. Light sliding wooden calipers with projecting prongs are very satisfactory for measuring these chest diameters.

The equation for predicting weight in pounds from height in inches and the two chest diameters in centimeters was found to be:
Weight = 2.65 × height + 2.56 × ch.depth + 2.59 × ch.width — 154.3
Since the three regression coefficients are so nearly equal, the sum of the

WELLESLEY WEIGHT PREDICTION TABLE FOR COLLEGE WOMEN

Sum of Skeletal Measures	Predicted Weight in Pounds	Sum of Skeletal Measures	Predicted Weight in Pounds	Sum of Skeletal Measures	Predicted Weight in Pounds
88.0	74.5	103.0	113.5	118.0	152.5
88.5	76.0	103.5	115.0	118.5	154.
89.0	77.0	104.0	116.0	119.0	155.0
89.5	78.5	104.5	117.5	119.5	156.5
90.0	79.5	105.0	118.5	120.0	157.5
90.5	81.0	105.5	120.0	120.5	159.0
91.0	82.5	106.0	121.5	121.0	160.5
91.5	83.5	106.5	122.5	121.5	161.5
92.0	85.0	107.0	124.0	122.0	163.0
92.5	86.0	107.5	125.0	122.5	164.0
93.0	87.5	108.0	126.5	123.0	165.5
93.5	89.0	108.5	128.0	123.5	167.0
94.0	90.0	109.0	129.0	124.0	168.0
94.5	91.5	109.5	130.5	124.5	169.5
95.0	92.5	110.0	131.5	125.0	170.5
95.5	94.0	110.5	133.0	125.5	172.0
96.0	95.5	111.0	134.5	126.0	173.5
96.5	96.5	111.5	135.5	126.5	174.5
97.0	98.0	112.0	137.0	127.0	176.0
97.5	99.0	112.5	138.0	127.5	177.0
98.0	100.5	113.0	139.5	128.0	178.5
98.5	102.0	113.5	141.0	128.5	180.0
99.0	103.0	114.0	142.0	129.0	181.0
99.5	104.5	114.5	143.5	129.5	182.5
100.0	105.5	115.0	144.5	130.0	183.5
100.5	107.0	115.5	146.0	130.5	185.0
101.0	108.5	116.0	147.5	131.0	186.5
101.5	109.5	116.5	148.5	131.5	187.5
102.0	111.0	117.0	150.0		
102.5	112.0	117.5	151.0		

three measurements can be multiplied by a common factor and the regression equation becomes:

$$\text{Weight} = 2.6 \times \text{sum of measurements} - 154.3$$

The Wellesley weight prediction table is merely a series of solutions for this equation.

The coefficient of multiple correlation which represents the relationship between actual weights and those predicted from height, chest depth, and chest width is .712. The predictive index is 30 and the probable error of estimate is 4.6 pounds. These figures may be interpreted to mean that the Wellesley method of determining "normal" weight is only moderately efficient and that 50 per cent of the subjects are likely to weigh within 4.6 pounds of the predicted weight. The factors of age and hip width do not materially add to the effiiciency of prediction.

Because the correlation between age and weight is negligible for women of college age, the age-height-weight tables virtually predict weight from height alone. In the present study, the correlation between weight and height for the 1,580 cases was .567 and the corresponding predictive index was 17. The chest-height-weight tables with a predictive index of 30 are therefore about twice as good as the age-height-weight tables.

Both tables were used during the physical examination of entering students at Wellesley College in the fall of 1939. According to the following statistical summary of the 366 cases studied, it is evident that the new tables make a better allowance for differences in body build, the actual weight comes closer to the predicted weight, and more cases fall within ten pounds of the so-called "normal" weight.

	Age-Height-Weight	Chest-Height-Weight
Range of deviation from predicted weight	—25 to + 64 lbs.	—25 to + 39 lbs.
Mean deviation from predicted weight	6.8 lbs.	1.8 lbs.
More than 10 lbs. underweight	25	36
Within 10 lbs. of predicted wt.	212	267
Overweight 10 lbs. or more	129	63

Additional information as to the relative merits of the two tables is to be obtained during the next year or so. The question of the applicability of the Wellesley table to sophomores and juniors is also being considered.

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The Correlation of Rogers' Test of Physical Capacity and the Cubberley and Cozens Measurement of Achievement in Basketball

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A NUMBER of studies have been undertaken using Rogers' Physical Fitness Test.[1]* Most of these projects have used boys as subjects and their performances in various athletic events have been correlated with their scores on the Physical Capacity Test. Interesting results have been obtained with boys in which the importance of strength has been shown to be a factor in athletic attainment.

Only a limited number of studies have been conducted, using girls as subjects, in which an attempt has been made to determine the value of strength as a predictor of athletic ability. Anderson concludes from her studies that neither the "total strength" nor the Physical Fitness Index is a very valid predictor of the athletic ability of the girls whom she tested.[2] Using 300 high school girls, Anderson combined and weighted strength tests. She omitted the lung capacity measurement and used McCloy's method of computing arm strength [3] and also added the measure of thigh flexor strength. The criterion was obtained through the use of track events: (*a*) 40-yard dash, (*b*) standing broad jump, (*c*) running high jump, (*d*) basketball throw.

The correlation of the unweighted Strength Index with the criterion is given as .460; the correlation with the Physical Fitness Index .440; and the multiple correlation of the weighted Physical Fitness Index .489. The weighted battery of strength tests with the track and field events gave a correlation of .5507.

Later Anderson,[4] using the same group of girls whom she rated subjectively as to motor performance and also the same strength testing data plus the Sargent Jump, lists the following findings:

Correlations of:	*With Subjective Ratings:*
Unweighted Strength Index	.437
Weighted Index	.417
Unweighted Physical Fitness Index	.425
Weighted Physical Fitness Index	.345
Sargent Jump	.609

* Refer to numbered Bibliography at end of article.

Another interesting study using strength testing with women was conducted by Howland,[5] in which the Rogers' Physical Fitness Index test was given six times in groups of two series to ninety-one Battle Creek College women students. She found that: (*a*) The average gain in strength from the pre-menstrual period test to the post-menstrual period test was approximately 12 per cent for students who were not otherwise ill in the meantime. The average gain in strength from the post-menstrual test to the mid-month test was 19 per cent for students who were not otherwise ill. She also found that: (*b*) The average loss in strength between the mid-month period test and the pre-menstrual period test was 15 per cent for students not otherwise ill in the meantime. Thus it appears that women are weakest physically just before the menstrual period begins and that strength increases as the period progresses. It appears that the mid-month period is the time of greatest physical power.

The Basketball Achievement Test which has been used in this study has been validated only to the extent that the experts who devised it consider that the skills used are those employed in the game of basketball. It then may be considered only a rough estimate of playing ability, which characteristic is also true of validated tests of ability to play various games.

STATEMENT OF PROBLEM

The present study proposes to use girls as subjects and to estimate the correlation between Rogers' test and the Cubberley and Cozens test of Basketball Achievement [6] through the use of multiple correlation.

METHODS AND MATERIALS OF STUDY

The subjects used in this study were sixty-four college students at the University of Wichita. All students are required to take four semesters of physical education and are given a free choice of activities, except in those cases where the findings in the medical examination indicate the advisability of restricted exercise or rest. The above students registered for basketball and were equally divided into two groups, each meeting two days a week at one o'clock.

The sixty-four students were classified in the University as follows: freshmen, twenty-eight; sophomores, twenty-nine; juniors, two; seniors, three. No attempt was made to limit the group to beginning players in basketball. Later it was found that approximately 60 per cent had one or less seasons of playing experience with the remainder indicating as much as six years of participation in playing basketball.

At the first meeting of each class the record blank to be used was distributed and the cooperation of the group asked in order that the results might be as reliable as possible. Something of the purpose of the test was explained and also the subjects were told that the groups would be divided into squads on the basis of the results. Students were re-

quested to eat a light lunch on the day their class met. In addition, each student was asked not to take part in any tests during the two days preceding and the five days following the beginning of the menstrual period.

Assistants were given special training and were not members of either group. In every case they were either upperclassmen or graduates. The director of physical education for men gave the back and leg dynamometer tests. It was further arranged that the same assistant gave the same test in both groups.

The tests for Basketball Achievement were given first and an individual was able to complete them in two class meetings. A third class period was used for the taking of the height, weight, spirometer, and grip tests. The remainder of the strength tests was completed at the fourth meeting of the class.

The Cubberley and Cozens Basketball Achievement Test consisted of:

a) Throw for goal (best of two trials).
b) Jump and reach (best of three trials).
c) Push pass for speed and accuracy (best of two trials).
d) Pass for accuracy (best of two trials).
e) Pivot and pass (best of two trials).
f) Throw for distance (best of two trials).
g) Pivot and dribble (best of two trials).

The pivot and dribble test was omitted from the battery as it was found to consume too much time and also because it was almost impossible to get accurate measurements.

Because a target of three concentric rings, with an over-all diameter of five feet, was used in tests *c* and *d*, three judges acted as scorers of test *c* and the average of the three was taken as each individual's score. Later the intercorrelations of the three judges' opinions were found to be very high ($.962 \pm .006$, $.963 \pm .006$, $.982 \pm .003$), so that this procedure would not have been necessary.

The scale published by Cozens and Cubberley[6] was used in computing the total Basketball Achievement score.

Rogers' Physical Fitness Test consists of a battery of strength tests from which the Strength Index is obtained. The Physical Fitness Index is obtained by dividing the norm into the Strength Index. A table of these norms based on age and weight has been published by Rogers.[7] The nine parts of the test are: (*a*) weight, (*b*) height, (*c*) lung capacity, (*d*) right grip, (*e*) left grip, (*f*) leg lift, (*g*) back lift, (*h*) pull-up, (*i*) push-up.

The strength of the arms is computed by multiplying the "multiplier," obtained from the formula

$$\frac{\text{Wt}}{10} + (\text{Ht-60})$$

by the sum of the pull-ups and push-ups. (Thus a girl whose weight was 135 pounds and height 65 inches and who had a total of 13 pull-ups and push-ups would have an arm strength of 240 pounds.

The dynamometers used in giving the tests for back and leg and grip strength were carefully tested. A wet spirometer such as suggested by Rogers was used and also his manual of directions.

It should be mentioned that both tests were repeated eight weeks after the initial testing as a check for reliability. However, the intercorrelation and regression equations were computed from the results of the first tests.

MULTIPLE CORRELATION

Using the composite score of the Basketball Achievement Test as the criterion, the intercorrelations between it and the items in the Strength Index Test were computed and also the intercorrelations of the parts of the Strength Index Test. These are shown in Table I.

TABLE I

INTERCORRELATIONS

	1	2	3	4	5	6	7
1. Basketball achievement		.352	.290	.207	.447	.383	.550
2. Lung capacity	.352		.486	.310	.360	.349	—.004
3. Right grip	.290	.486		.652	.372	.390	.156
4. Left grip	.207	.310	.652		.231	.235	.098
5. Back lift	.447	.360	.372	.231		.574	.196
6. Leg lift	.383	.349	.390	.235	.574		.206
7. Arm strength	.550	—.004	.156	.098	.196	.206	

It should be noted that arm strength yields the highest correlation, .550, with Basketball Achievement, but shows a low correlation with other parts of the battery of tests. The fact that the other strength tests correlate with Basketball Achievement and yet give a low correlation with arm strength indicates that arm strength and the other parts of the strength test do not measure exactly the same thing. Therefore, the other strength tests combine with arm strength to predict the basketball test to a fairly high degree.

In order to compute regression equations, the means and standard deviations of the composite Basketball Achievement Test and the parts of the Strength Index battery were determined. (See Table II.)

Using the Basketball Achievement Test as a criterion, it was found that the multiple correlation existing between this criterion and a composite score based on lung capacity, back lift, and arm strength was .694. Addition of other parts of the Strength Index Test did not appreciably increase this correlation. This is only slightly larger than the product-moment correlation of the composite scores of the two tests, Basketball Achievement and the Strength Index, which was .687. The correlation between the composite Basketball Achievement scores and

the Physical Fitness Index yielded a product-moment correlation of .468.

TABLE II

MEANS AND STANDARD DEVIATIONS

	Number Cases	X	S
Basketball achievement	64	264.060	63.360
Lung capacity	64	185.470	25.830
Right grip	64	71.157	9.597
Left grip	64	64.218	9.318
Back lift	64	196.635	39.105
Leg lift	64	309.520	78.300
Arm strength	64	290.650	138.600

The regression equation for prediction of Basketball Achievement is

$$X_1 = .644X_2 + .411X_5 + .299X_7 - 23.10$$

where X_2 is the individual's lung capacity, X_5 back lift, and X_7 arm strength. The Probable Error of Estimate is ± 30.770. The maximum possible score on the Basketball Achievement test being 585, real scores then would not be likely to vary more than 10 per cent above or below scores obtained from this equation.

CORRECTION FOR ATTENUATION

The accuracy of any series of test scores of capacity is conditioned by the number and size of the chance variations or "errors of observation." Such variations tend to increase the standard deviation of the distribution and to decrease a coefficient of correlation calculated between series in which they are present. Special formulas have been devised to rule out the effect of these observational errors. In order to use these formulas it is first necessary to have two independent measures of each capacity. It will be recalled that two independent measures were made of the test items in both the Basketball Achievement and Strength Index Tests.

The true correlation, then, between the basketball Achievement and Strength Index Tests would be the correlation between the two tests after correction for attenuation. The formula which was used for correction for attenuation is as follows:

$$r_{SB} = \sqrt{\frac{(r_{S_1B_1})\ (r_{S_2B_2})}{(r_{S_1S_2})\ (r_{B_1B_2})}}$$

$r_{S_1B_1}$ = Correlation between first Strength Index Test and first Basketball Achievement Test. Numerical value is .657.

$r_{S_2B_2}$ = Correlation between second Strength Index Test and second Basketball Achievement Test. Numerical value is .687.

$r_{S_1S_2}$ and $r_{B_1B_2}$ = Correlations between the first and second tests of each capacity. Numerical values are .773 and .893 respectively.

The coefficient of correlation between Basketball Achievement and the Strength Index, correction for attenuation having been made, is .809. This figure represents simply the relationship between strength and whatever is measured by the Basketball Achievement Test, and is not the correlation that would be obtained between these tests administered but once each. It does mean, however, that strength is important in whatever it takes to perform the skills required by the basketball test up to a correlation of .809.

VALIDITY

Some indication of the validity of both the Basketball Achievement Test and the Strength Index was obtained through the use made of them in the two classes from which the subjects for this study were drawn and as contained in an unpublished paper. Following their administration, one class was divided into equal squads, A, B, and C, in terms of achievement based on the basketball test. In the other class a similar classification was made, based on the Strength Index. Following the completion of a double round-robin tournament held within each class, it was found that in both groups squad A had won all their games, squad B had lost only to squad A, and squad C had lost all their games.

RELIABILITY

Approximately eight weeks after the first giving of both tests they were repeated. A fair degree of reliability for both tests is indicated, which would probably be greater had there been a shorter lapse of time between the taking of the two sets of scores. The product-moment correlation coefficient between the first and second was $.893 \pm .019$ and $.773 \pm .35$ for the Basketball Achievement and Strength Index Tests, respectively.

The reliability of the individual test items (obtained by computing the correlation between the two scores on the individual test items) is as follows:

Throw for goal	.770	Lung capacity	.824
Jump and reach	.769	Right grip	.761
Push pass	.535	Left grip	.759
Pivot and pass	.602	Leg lift	.697
Pass for accuracy	.548	Back lift	.746
Throw for distance	.730	Arm strength	.382

It is interesting to note that the reliability of the individual test items is not as high as the reliability of the tests as a whole.

SUMMARY AND CONCLUSIONS

Since it was the purpose of this study to determine the relationship between a battery of strength tests and a group of skills used in playing girls' basketball, the following conclusions are presented:

1. The multiple correlation of variables (lung capacity, back lift,

and arm strength) with the criterion (Basketball Achievement Test), indicates a positive relationship and also that these variables may be used to predict Basketball Achievement scores within fairly low limits of error.

2. The coefficient of correlation between the Basketball Achievement Test and the Strength Index Test after correction for attenuation was found to be .809.

3. The correlation of .550 between Basketball Achievement and arm strength was found to be the highest correlation between any two variables. This finding would lead one to believe that strength of arms plays a greater part in the acquiring of basketball skills than would ordinarily be thought. Other investigations in the field have also found that strength of arms showed great importance where boys were used as subjects and track events were a criteria of athletic ability.[8] However, it should be remembered that arm strength may be important, not because back and leg strength are not important, but because when one develops arm strength, general body strength usually develops.

4. Since the addition of lung capacity increased the multiple correlation perceptibly (.044), it may be considered of value in predicting basketball ability. When lung capacity is omitted from the Strength

TABLE III

MULTIPLE CORRELATIONS COMPUTED IN ORDER TO OBTAIN BEST POSSIBLE COMBINATION FROM WHICH TO PREDICT BASKETBALL ACHIEVEMENT SCORE

From Two Variables	From Three Variables	From Four Variables	From Five Variables	From Six Variables
R	R	R	R	R
1.23 = .377	1.234 = .378	1.2345 = .495	1.23456 = .508	1.234567 = .697
1.24 = .367	1.235 = .494	1.2346 = .454	1.23457 = .694	
1.25 = .491	1.236 = .452	1.2347 = .656	1.34567 = .662	
1.26 = .448	1.237 = .655	1.2356 = .506	1.24567 = .696	
1.27 = .654	1.245 = .495	1.2357 = .694	1.23467 = .675	
1.34 = .291	1.246 = .453	1.2367 = .674	1.23567 = .697	
1.35 = .466	1.247 = .656	1.2456 = .507		
1.36 = .412	1.256 = .505	1.2457 = .694		
1.37 = .587	1.257 = .694	1.2467 = .674		
1.45 = .459	1.267 = .673	1.2567 = .696		
1.46 = .401	1.345 = .468	1.3456 = .483		
1.47 = .571	1.346 = .413	1.3457 = .657		
1.56 = .473	1.347 = .588	1.3467 = .626		
1.57 = .650	1.356 = .482	1.3567 = .661		
1.67 = .615	1.357 = .656	1.4567 = .661		
	1.367 = .625			
	1.456 = .480			
	1.457 = .655			
	1.467 = .622			
	1.567 = .657			

1 = Basketball achievement
2 = Lung capacity
3 = Right grip
4 = Left grip
5 = Back lift
6 = Leg lift
7 = Arm strength

Index Test the coefficient of correlation between the first Strength Index Test and the Strength Index Test after correction for attenuation was .593. Although lung capacity may be a corollary of weight or general size, it seems to contribute something to the strength test in its prediction of basketball achievement.

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A Brief Study of Nutritional Status in Relation to Strength and Skill

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THIS "Brief Study of Nutritional Status in Relation to Strength and Skill" is the fifth of a series of data-collecting studies made by the Bureau of Nutrition and Health Education for the advancement of health education in Texas. It is hoped that this investigation may stimulate an active interest in the use of research material relative to more scientific methods of determining the nutritional status of children.

In the use of contributions from various fields by a specific group for the solution of its problems, we are seeing the basic philosophy underlying the newer education—that of integration. It is of little importance as to which group makes the contribution; the vital point is that use be made of all scientific material in the development of the curriculum. This idea is well expressed by Dr. James Houloose, Supervisor of the Health Service Department of the Long Beach Public Schools.

> When one looks at the history of medicine one must conclude that its growth and development have been the result of contributions from those both inside and outside its own professional family. Thus one sees the contribution of the physicist unfold for medicine the diagnostic and curative technic, the X-rays; the biologist finds and elaborates the gene; the biochemist isolates and produces the vitamin, another the hormones. The bacteriologist gives an insight into the modes and manners of an unseen microbiologic world. The psychologist portrays the motives and mechanisms of the mind. The sociologist and the anthropologist discover the purpose and plan of our complex social civilization. If one stops a moment to consider any of the other great professional fields, one sees this same variety of contributors assisting in the integration and development of each of the other sciences. To education in the last quarter century have come contributions from almost every other professional field. The engineer suggests a wholesome school environment through proper lighting, heating, ventilation, and seating. The health officer regulates and controls the morbidity of the school population through testing, immunization, and vaccination. The psychologist gives the technic and tools of measurement. The last to appear on the educational scene as a bearer of gifts is the mental hygienist.[1]

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[1] James Houloose, M.D., "Contribution of Mental Hygiene to Education on the

PURPOSE OF THE STUDY

In this study, it is hoped that at least one phase of this interrelatedness will be shown—the use that physical educators can make of scientific findings in other fields in order to base their work upon firmer, more scientific principles. The purposes may be stated as follows:

1. The selection of an undernourished group and a well-nourished group.
2. The investigation of the difference in strength and skill of the two groups.
3. The determination of the extent to which strength and skill seem to be related to musculature, subcutaneous tissue, and weight.

Data were gathered from five Texas school systems, and a generous sampling was taken in each town so that similar environmental, socio-economic, and racial districts were represented. For example, in each town three elementary schools were selected that corresponded roughly to the three economic rankings of income—high, average, and low. Only American whites were measured and these children were taught physical activities by the classroom teacher rather than by a trained physical education teacher in what was largely a play program.

There were measured a total of 3,611 children whose ages ranged from six years, six months to twelve years, five months. Of this number 1,872 were boys and 1,739 were girls; 894 were seven years of age, 653 were eight, 675 were nine, 694 were ten, 466 were eleven, and 229 were twelve. If a thousand cases and at least three hundred for each year of age are an advisable statistical number, then the numbers of this study should produce reliable findings.

In order to achieve the first objective of the study, the selection of an undernourished group and a well-nourished group, the Nutritional Status Indices were selected as the method of measurement. As you probably know, the American Child Health Association undertook comprehensive research because of the increasing demands for improved objective methods for determining the nutritional status of the child. As a result, they were able to offer this technique for measuring individual differences in nutritional status.

It may be propitious at this time to review the bases, limitations, and uses of the Nutritional Status Indices for a clear understanding of the brief resume of this study. Since the explanation has been so carefully and concisely stated, it is herein quoted from the book, *Nutritional Status Indices, Method of Obtaining Measures of Musculature, Subcutaneous Tissue, and Weight with Allowance for Skeletal Build.*

Elementary Level," *Journal of the American Medical Association,* 3 (December 31, 1938), 2447–9.

Bases for the Indices

As a part of its general research into measures of factors of health, the American Child Health Association investigated various estimates of nutritional status. The investigation included medical judgments together with a complete battery of anthropometic measurements—height, breadth of shoulders, breadth of chest, depth of chest, width of hips, weight, girth of the upper arm and of the calf, size of the deltoid muscle, and the thickness of subcutaneous tissue over different areas of the body. The measurements were taken on an extensive sampling of 10,000 children, 7 to 12 years of age, scattered throughout 75 cities of the United States.

An exhaustive analysis of the interrelationships of these measurements for the entire sampling, together with physician's judgments of the nutritional condition of a number of these children, led to the conclusion that the amount of musculature and of subcutaneous tissue relative to bony build are the important elements in any estimate of nutritional status. Deviation in weight for skeletal build was also shown to be an important measure.

Subsequent research showed that indices of these elements important to nutritional status estimate, namely musculature, subcutaneous tissue, and weight with allowance for the bony frame, may be obtained from a minimum of seven measurements—girth of the upper arm, amount of subcutaneous tissue over the biceps, weight, height, breadth of chest, depth of chest, and width of hips. The amount of subcutaneous tissue over the biceps is representative of the subcutaneous tissue over the entire body; likewise, the girth of the upper arm with adequate allowance for skeletal frame is indicative of the musculature of the entire body. Hereafter, "arm girth" and the "musculature" are used interchangeably.

The procedure in obtaining the three nutritional indices from the seven measurements has been simplified by the compilation of tables. By referring each of the seven measurements to the tables, a child's standing in each of the nutritional indices, among other children of this age, sex, and skeletal build, may be readily determined.

Limitations of the Indices

The indices reflect amounts of musculature, subcutaneous tissue, and weight, in relation to the size of the skeleton. They are not intended to supplant the physician in the diagnosing of malnutrition. Rather, they furnish the physician with more adequate evidence for his diagnosis than he has had in the past. Using these indices, in conjunction with other clinical signs, the physician can diagnose the condition and prescribe what shall be done. It is not intended that these measures should be used alone to label a child as nutritionally healthy or as malnourished. Diagnosing and stating the child's condition remains the function of the physician.

Tables for determining the three indices are available only for the ages 7 to 12 years inclusive. Additional research is needed to establish indices of nutritional status in the lower ages and also in the upper ages.

Uses of the Nutritional Status Indices

1. As a means of selecting children for reference to a physician. In the pamphlet entitled, "The ACH Index of Nutritional Status,"[2] three procedures for identifying children with small amounts of musculature and subcutaneous tissue relative to bony build are described. One of these is the use of the ACH Index alone. The other two procedures require the use of the three "nutritional status indices."

The first of these two latter methods requires the application of all seven of the measures to every child in the group studied. After referring the obtained measurements to the tables, the children who are low in all three of the nutritional indices—musculature for skeletal build, subcutaneous tissue for skeletal build, and weight for skeletal build—are revealed. This method is by far the most accurate, and is to be preferred in all situations where testing time is not at a premium and complete data are desired, or when only a very few cases are concerned. Throughout schools in general, the time element is of course of great importance, and for that reason this procedure is impractical for routine school use.

The second of these two methods involves the application of the three measures used in the ACH Index of Nutritional Status—arm girth, chest depth, and hip width—with the standard of selection set so as to select a fourth of the children.* To this fourth the remaining four of the seven measures are applied. By using the ACH Index, with the standard so adjusted, as a preliminary screening device an economy in testing time is accomplished, and the application of the other four measures to the screened group identifies over 90 per cent of the children who would be selected if all seven measures were applied to the entire group. The children so selected should then be referred to a physician together with the measured evidence on the adequacy of their muscular and adipose tissue.

2. As an aid to physicians in diagnosing malnutrition. When an individual physician is asked to rate children in general terms of nutritional status, his ratings are made in accordance with *his* estimate of their muscular and adipose tissue. But individual judgment of these factors is known to differ appreciably because of the difficulty in making proper allowance for the complicated differences in skeletal build. The three indices here proposed overcome that difficulty in that they provide the physician with measures of the amount of musculature and subcutaneous tissue. Instead of using *subjective* judgment of the adequacy of a child's soft tissue, the physician can now make his diagnosis on the basis of *measured evidence*. If a child has muscles that are smaller than the muscles of a great majority of children of his age and sex who have the same skeletal build as he, and his adipose tissue is likewise meager, this information becomes an important factor to be considered in making a judgment concerning the child's nutritional status.

3. As a tool of research. The three indices—musculature, subcutaneous tissue, and weight—may be used as measures in appraising nutritional status

[2] Raymond Franzen and George T. Palmer, "The ACH Index of Nutritional Status," American Child Health Association. Secure from The American Public Health Association, 50 West 50th Street. New York City.

* The scale as published in the ACH Index selects only 10 per cent. Scales for selecting 14, 20, and 25 per cent are given as Table Z which appears on page 66 in *Nutritional Status Indices*.

in nutritional and growth investigations. Because the measurements are objective, they are freed from the errors of personal judgment and are therefore valuable in the comparison of school or other groups whether it be one school with another, or one community with another. They are also useful in the determination of individual changes over a period of time.[3]

For all measurements, the children were asked to remove any heavy clothing as coats or sweaters, and boys were required to empty their pockets. The upper arm was laid bare and only thin layers of clothing were permitted to cover the chest. The hip measurement was taken over the clothing. The instruments used for taking the seven measurements were: scales, accurate to one-fourth of a pound, for taking weight; a stadiometer or square, consisting of two flat pieces of wood joined at right angles, for measuring height; a steel tape equipped with a Gulick spring handle for securing arm girth; a large sliding wooden caliper for hip width, chest depth, and chest breadth; and a special subcutaneous tissue caliper for determining the subcutaneous tissue over the biceps. The last three instruments are now obtainable from the American Public Health Association.

It has been stated already that the three indices important to a consideration of nutritional status are arm girth or musculature, subcutaneous tissue, and weight with allowance for the bony frame. In considering the purposes of this study, it was decided to use these Nutritional Status Indices in the following manner. Three of the seven required measures for determining these indices—arm girth, chest depth, and hip width—are in effect the ACH Index. These three measures were applied to the entire group, and were adjusted to screen out approximately 25 per cent of those measured. To the group that was screened out, the remaining four measures were administered. These consisted of height, weight, chest breadth, and subcutaneous tissue over the biceps.

To facilitate the recording, a score card was drawn up so that both the measurements and the test results could be recorded on one sheet. The first three measurements were taken, recorded, and the index figured out immediately to determine whether the pupil would be screened out as undernourished. If he were, the four additional measures could be given at once and thus avoid calling the same pupil out of class any more than necessary. The computation of the indices was made possible by referring each of the seven measures to its respective table, and the table figure was placed in the correct column. The final derivation of the three indices was a mere mathematical procedure. By the use of other tables each nutritional index of a child could be compared to that of other children like him in age and skeletal build.

There were 600 or 16.62 per cent of the 3,611 children who were

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[3] American Child Health Association, *Nutritional Status Indices*, 1935. Secure from The American Public Health Association, 50 West 50th Street, New York. Reprinted by permission of The American Public Health Association, New York.

screened out as undernourished. From these 600, 56 were lost due to further screening and 28 were lost due to absences at the time of the final testing. The nutritional status indices were calculated for the 600 undernourished children so that those whose scores in musculature, subcutaneous tissue, and weight were 46 and above in the three, could be discarded from the undernourished group. The score of 46 was selected with reference to a special table worked out by the research specialists to facilitate a reclassing of children for special treatment. By this method of elimination, it was assured that the group listed as "undernourished" were unquestionably so. This accounted for the loss of 56. Thus there were 516 (263 boys and 253 girls) who were definitely classed as undernourished. Since the number screened out per 1,000 for boys and girls was approximately the same, it indicates probably that there is no appreciable difference in the number of undernourished in the two sexes. However, when the sexes were examined by ages, it was interesting to note that there was a progressive increase in the number of undernourished screened out for ages 7 through 12 years. The progression in the increase of numbers screened out per 1,000 for the boys was unbroken, whereas for the girls there was a slight deviation at ages 9 and 11. It would seem then, that the older the children the greater the incidence of undernourishment. It is generally believed that the preadolescent ages represent, perhaps, one of the healthiest physical levels of man. The growth and development of children at this age level is spoken of as sturdy. If well-nourishment is a characteristic of health, why should those supposedly healthy children show a progressive undernourishment? An element which might have accounted for the seemingly higher frequency of undernourishment in the 12-year-old group is the fact that the majority of children tested were in the elementary school. Well-developed children who could pass as being older might have been more apt to have dropped out of school to work than weak and young-looking 12-year olds; while bright children of this age might be in junior high school and thus have escaped the testing. (If mental and physical development agree, the brighter children should not be physically retarded.)

Each pupil in this undernourished group was matched with one in the well-nourished group according to age and sex. Scores for each measurement for the two goups were placed in separate tables for the ease of making comparisons. For example, one table is entitled, "Height of Well-Nourished and Undernourished Age Groups by Sex, Range, Mean, and Reliability of the Difference." The age groups were divided into those 7–9 years of age and those 10–12 years of age.

In order to accomplish the second purpose of the study—the investigation of the differences in strength and skill of the two groups—tests for determining muscular strength, skill, and coordination were selected. In searching for suitable tests, various ones were investigated and those

offering the best reliability were selected. The three strength tests were hand grip, pull-ups, and push-ups. These were selected to determine the strength of the child since each test has excellent reliability and the combination of the three has been used as a successful short strength index. The selection of the three skill tests was somewhat difficult to make. Two of the tests selected were jump and reach and standing broad jump. These tests have excellent reliability and seem to require skill in performance. The speed throw test was chosen because it calls for a selected skill, and at the same time requires the coordination of a large part of the body. Each test was demonstrated carefully before the group attempted it. The 516 undernourished and 516 well-nourished were given the six tests in matched pairs, and results were recorded on the score card previously mentioned. For comparison, separate tables for each test with the scores of both groups were organized on the same age group basis by sex, range, mean, and per cent of reliability of the difference.

The last purpose was to find out the extent to which strength and skill seem to be related to musculature, subcutaneous tissue, and weight. The undernourished group was chosen as all seven measures had been given to this group, and for that reason the three nutritional status indices could be determined for this group only. It is felt that the findings for this group alone will show definite trends. In order to find out whether there might be differences in the above relationships for the higher, border-line, and lower scores, they were further subdivided by use of the special table and the score of 46 was chosen as the dividing line. All pupils whose score in the three indices was 46 or over were put into one group and those whose scores were 45.9 and below were divided further into those whose scores in all three indices were 40–45.9 and into those whose scores were 40 or below. For convenience and ease of interpretation, the findings concerning mean total strength and skill scores and their relation to nutritional status index scores were organized into four tables on the same age and sex grouping as the previous tables.

FINDINGS

Findings in this study show trends and relationships rather than correlations. In terms of the procedures utilized in this investigation, the findings lend support to the belief that:

1. Undernourishment is about as frequent among boys as girls.
2. The older the children the greater the number screened out per 1,000 as undernourished.
3. Undernourished children seem to be taller in stature and lighter in weight than the well-nourished.
4. Well-nourished children seem to be shorter in stature, heavier in weight, and larger in arm girth than undernourished children.

5. Undernourished children appear to be definitely inferior in strength to the well-nourished children.

6. The undernourished and well-nourished groups are about equal in skill abilities.

7. The arm girth, subcutaneous tissue, and weight indices of the undernourished groups seem to have little or no relationship to their ability in strength and skill.

8. In considering the undernourished group, the degree of "underness" had little effect upon their strength and skill tests.

9. The majority of undernourished children had scores that fell well below 46 in all three indices.

What are the practical values of this study? In considering the trend of education, it is encouraging to see that integration is being accomplished through a revision or improvement of the curriculum. The philosophy underlying this change is that the needs, interest, and capabilities of the child are the bases for defining problems, the solutions to which are effected through a use of personnel, materials, and information, from all subject matter divisions irrespective of boundary lines. This would mean, then, that all teachers regardless of their specialization, would draw upon various fields in the guidance they give pupils. The physical educator, nurse, homeroom teacher, and core curriculum teacher—all will be interested in not only the physical status of the pupil but his mental, emotional, and social, as well. According to his training and facilities, each will make his contribution. It may be that the nurse or physical educator will be interested in using the Nutritional Status Indices to screen out pupils for reference to the physician who may be either the family or school physician. Perhaps the school physician will become interested in using the findings revealed by the indices to help him make a more objective judgment of the nutritional status of children from seven to twelve years of age. He may be interested also in the findings of this study that reveal trends concerning the two groups—undernourished and well-nourished—in relation to weight, height, musculature, and subcutaneous tissue.

The nutritional status of the pupil is but one phase of the total physical picture. The findings of the Nutritional Status Indices of a child may indicate a weight index that is too large in comparison to others of his sex and skeletal build, or they may place the pupil in the undernourished group. Such findings should serve as an impetus to locate conditions in the pupil's daily life that may be contributing causes of the condition. Are the pupil's sleeping and eating habits desirable? Should the pupil be advised to confer with the home economics teacher about his nutritional needs? Is the daily schedule at school too fatiguing? Is the pupil delinquent in taking sufficient exercise? Are absences because of illness frequent? And many similar leads can be used in the health guidance of the pupil. The physical educator is par-

ticularly interested in basing his physical education upon the pupil's needs, limitations, and abilities. By a study of the nutritional status indices of each pupil, this teacher can discover many facts that should be of value in his guidance role. First, he is interested in securing the advice of the physician to eliminate any organic or functional disorder as a cause of over or undernourishment and to learn more about the physical status of the pupil; then, he can compare each index of a child with that of other children of the same age, sex, and skeletal build by the use of a specific table. Is the pupil's arm girth or musculature poor in relation to that of the group under comparison? If so, is this due to this pupil's failure to take part in that phase of physical activity that would aid in developing these muscles? Has the physical education teacher planned his program to care for this particular development? Would attention to and planning for this, result in better pupil participation in certain activities with more pleasure accruing from them? In reference to the finding that undernourished children appear to be definitely inferior in strength to the well-nourished children, perhaps, acting upon the physician's suggestion, the physical education teacher may advise the pupil to take rest instead of activity in order to contribute to the improvement of his nutritional status. Applying this same finding, the teacher should be able to place each pupil in the physical activity that best meets his needs and abilities. He will avoid giving these undernourished pupils activities that call for superior strength until their nutritional status is improved, because their ineffectual participation may cause undesirable attitudes and thwartings. So it may be seen that for the best interests of the pupil, he must be considered as an organic whole or an entity—the physical educator, the nurse, the doctor, the core curriculum teacher, and the administrator must coordinate their efforts in planning for an integrated program that will meet the needs, interests, and abilities of the pupils.

These are briefly a few of the desired outcomes that may accrue from such a study as this. Another research study dealing with measurements has been made by Dr. Jessie Whitacre, Chief of the Division of Rural Home Research at the Agricultural and Mechanical College of Texas. It is entitled, "Some Body Measurements of Texas School Children."

It is hoped, as has been stated before, that in a small way this study may serve as a stimulus to others to make available, material that can be used not only by health and physical educators but by others who are responsible for the guidance of children.

The Philosophical or Group Thinking Method of Research

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PROBLEMS which involve subjective data or which can be solved most expeditiously by *pooled thinking*, rather than by experimental, measurement, or statistical techniques, are a common occurrence in education, law, theology, government, and business. The approach to the solution is fundamentally *philosophical*: "If one specializes in the critical examination of data, educational theories, hypotheses, and generalizations in the light of evidence already available, we call him an educational philosopher."

Education is closely linked with philosophy, in fact, may be thought of as a branch of philosophy. Its fundamental precepts, assumptions, and methods rest largely upon a basis of idealistic beliefs. In America these largely center around the concepts involved in democracy. It is no chance relationship, therefore, the relationship between democratic beliefs and the group thinking method (pooled thought method) of research.

Some examples of research which use the *evaluative* or *group discussion* method are given by Carter V. Good in his book *How To Do Research in Education*.[1]* Typical among these types of problems are the following:

1. Establishing *criteria* for the rating of materials, programs, courses of study, policies, etc. Curriculum studies may involve this procedure as one approach.[2, 3, 4] An example of the *group thinking* method of evaluating ideas, or materials, might be the 1926 yearbook committee of the National Society for the Study of Education composed of Bagley, Bobbitt, Bonser, Charters, Counts, Courtis, Horn, Judd, Kelly, Kilpatrick, Rugg, and Works as they met and agreed on 58 statements which they considered expressive of the best available principles to be observed in curriculum building. Phelps has explained the contribution of the philosophical method to the solution of curriculum problems.[5]

2. Most lines of educational research are conditioned by the governing viewpoint in educational philosophy. Kilpatrick [6] has described the relations between philosophy and scientific research. The agreement on fundamental assumptions may be an important and governing step in any research. Many educational problems are solved for the time being—so as to permit action—by this procedure alone, i.e., meeting in group deliberation and coming to a

A paper describing a project conducted with the cooperation of Dr. R. B. Raup, Teachers College, Columbia University.

* Refer to numbered Bibliography at end of article.

decision. This is especially true of studies involving the aims and objectives of educational procedures. Kilpatrick [6] emphasizes the point that many problems are solved by philosophically weighing the issues. This writer used the philosophical procedure to evaluate certain methods and procedures of the classroom.[7] Many writers stress the importance of philosophical deliberation, or reflective thinking, as the basic procedure for determining fundamental assumptions.[8, 9, 10]

3. A most important and sometimes neglected aspect is the consideration of the purpose of research. This must be determined by an evaluational rather than a measurement procedure. In this process, reasoning and the influence of held values, emotions, and many unmeasurable influences operate to give shape and form to the purpose of research. Raup [11] has shown the limitations of the older view of the scientific method in trying to eliminate wish, desire, preference, etc. All these certainly condition the sense of values. Thus, forming judgments about the purpose of research is very much influenced.

4. The evaluation of the results of research through the conference or group thinking method opens the way to action. A wider use of the method would reduce the lag between theory and practice, between known possible procedures and actually used procedures. The need for interpretation of results has been emphasized by Brooks [12] and in other articles.[13]

It may be seen by careful consideration of the above statements that research is conditioned from start to finish by philosophical concepts and that group thinking is helpful, perhaps the best way to treat many problems.

WHAT IS RESEARCH?

We may well ask what research is by definition. The *New International Dictionary* defines the process as follows: "Research is a careful or critical inquiry or examination in seeking facts or principles."

Carter V. Good [14] stresses the part which reflective thinking plays in research: "Research per se constitutes a method for the discovery of truth which is really a method of critical thinking." "Reflective thinking is the name given to the mental process of discovering rules and principles."

Research is carried out by following the steps of the scientific method. The scientific method is made up of six or seven steps which use at every step combinations of deductive and inductive reasoning.

A very recent book on research methodology [14] takes the position that there should be no conflict between the methods of science and philosophy. The procedures are intertwined. Measurement is incomplete as a research process without critical thinking at every stage. Philosophical method is likewise incomplete unless it uses the best data available and proceeds essentially in the same steps of the scientific method. Research is a broader process than steps two and three of the scientific method, namely, collecting data and treating it mathematically. Some types of problems yield admirably to extensive procedures at steps

two and three, these being of a statistical or quantitative nature, but other problems are not so susceptible. The procedures for securing (1) exact identity of the item, (2) consistency of agreement, (3) accuracy, i.e., relative truthfulness or exact suitableness of the result, all vary with the nature of the problem and with the conditions or purposes of the study.

There is no precision method which does not involve critical thinking about identity, relationships, purposes, values, and philosophy of some kind. No one should ever say that the scientific method is *only* measurement without philosophical treatment. No measurement method is an adequate substitute for reasoning, but reasoning may be helped at certain stages by systematic, even mechanical, methods of grouping data so that the complexity of the relationships is reduced. Logical reasoning is the primary, basic, all-pervading process which characterizes every step of the scientific method.

Steps.—The *group thinking* method of research may follow the essential steps of the scientific method:

1. Formulation of a definite problem—with consideration of its purpose and significance, also its background in educational philosophy—carefully de-limited to workable size.

2. Data collecting—fact finding. This might involve a consensus by questionnaire, by interview, by group thinking in conference. The amount of objectivity and reliability is relatively dependent upon the nature of the problem and the relative perfection of the methods for dealing with the particular type of problem. There is no rigid rule that there must be instrumental measurement.

3. Tabulating, graphing, critical thinking upon the trends of the opinions or data. This may be done by stenographic record in the group thinking type of research.

4. Report on tentative, or trial conclusions. This might be done by the process of vote on formulated statements or by editorial report.

5. Testing the conclusions, by appointing committees to work intensively on sub-units, to make all possible comparisons, to ask other authorities their opinions, to actually put into practice in trial situations. Try to discover if the conclusions are generally suited to most situations or are unjustified owing to the bias or lack of experience of the group.

6. Reformulation, or adjustment to the results of testing on larger numbers, of the conclusions. Even here there should not be an attitude of *finality* expressed.

7. Publication of the findings. They may be only partly true or representative. They do not have to be invariable laws, although the latter type is the goal of workers in the physical sciences.

The steps of the scientific method as outlined above and adapted to the procedure usually followed in group thinking are essentially the same as the steps or logical phases of thinking as outlined by Dewey.[15]

Research is, then, essentially effective thinking covering the widest scope and dealing with the best possible data which is permitted by the situation.

The process of problem solving is the scientific method. It is not restricted to instrumental measurement. The group thinking method is more applicable to broad social and educational problems than any form of measurement. The "facts" for which every inquiry reaches out are propositions for whose truth there is considerable evidence. There may be various ways of calling attention to the evidence. The aim is to give the simplest and most truthful account which will systematize the statements of available knowledge.

RECOGNITION OF BROAD METHODS OF PROBLEM SOLVING

Abelson [16] makes a distinct effort in his book, *The Art of Educational Research,* to promote recognition of the broader approach to research. In this book there is presented the "integrative method," which combines the findings of several studies (pp. 50-63). The integration or synthesis is done by editorial method, using normative concepts as a background for interpretation. New data are not added but new conclusions are as a result of the convergence of critical thinking upon the pooled data. This is a means of reducing the breach between educational theory and practice. The results are rationalized in the light of desirable practices. The steps are:

1. Choice of problem.
2. De-limitation of problem.
3. Analysis of problem (critical thinking).
4. Locating references.
5. Merge evidence from several studies.
6. Critical comparison of results in studies.
7. Arrangement and organization.
8. Formulation of conclusions.
9. Publication of report.

Abelson goes beyond this and presents the process of "speculation as a tool" (pp. 259-273). Speculation is imaginative thought in process. There is no objection to speculation on values. Speculation is directed thinking.

Dewey's steps in the thinking process make the core of the method:

1. A felt difficulty-problem.
2. Its location and definition.
3. Suggestions for possible solution.
4. Reasoning upon the implications of the solution.
5. Observation or experimentation leading to acceptance or rejection.

In the speculative method, observation and speculation are constantly interacting. The study of data leads to the formulation of conclusions

(inductive mental process). The application of principles to a situation leads to the clarification of facts (deductive mental process).

The basic stimulation in the speculative method is *interest*. Ability in insight is largely due to an enriched background. Time for thoughts to mature is an important element. Diagramming relationships will help. Speculation on the part of a group with interacting thought is helpful because invariably more ideas are brought into the picture.

Abelson presents still again the "constructive method" (pp. 287–299). In this he is mainly describing the method of making what the logicians would call a proposition. It is the reconstruction of a normative principle.

Abelson also develops at length the "evaluative method" for dealing with subjective elements. This is essentially the philosophical method. He states that its principal use is to make decisions on problems *now*, not to wait for experimental results. It is also applied to determining the worth of research—the value of the totality of the effect produced.

THE PROCESS OF GROUP THINKING

A number of writers have described the process of group thinking in conferences. Follett,[17] Elliott,[18], Sheffield,[19] the National Council of the Y.M.C.A.,[20] and the Inquiry [20] have prepared materials describing the conference method. Elliott [21] states that the essential steps are:

1. Get question in the open—what problem? Use the general assembly to set the problem before the entire group. What are the important factors? What is the procedure of attack?

2. What to do? Organize small groups, each attack a limited phase, carefully selected. Formulate theses or resolutions on materials in hand. Take notes and list reasons. Nominate spokesman to report to assembly. Explore differences of opinion—try to get factual basis. Try to recognize fundamental agreements.

3. Report to general assembly results of small group analysis. Invite further discussion. Get experts to summarize. Vote for approval or disapproval.

4. Appoint committees to put in action results, working by units.

5. Edit the whole.

6. Publish the report.

Limitations.—(*a*) The members convened may have limited experience or thinking ability.

b) Even an expert group may not develop all relations because of limitations of time or diverting too much attention to one phase.

c) One expert may be outweighed in democratic vote when he may be the only one right in the group because of possessing new or unusual knowledge.

d) The thinking of an individual and also of a group is affected by "value clusters" held, i.e., the purposes and motives behind the thinking.

e) Time and place may have affected the thinking very seriously. A "short view" may predominate whereas the "long view" may be more helpful.

Elliott points out some additional difficulties or limitations of group thinking:

f) When policies are agreed upon by a group, most of the executive direction of the activity agreed upon must fall to individuals.

g) Emergency decisions require dictatorial action and there may be no time for conference.

h) Some situations may involve issues which are not easily discussable. It may be clear at the time that discussion will not help.

i) Some problems are dangerous to discuss openly.

EXAMPLE OF GROUP THINKING RESEARCH

The National Council of the Y.M.C.A. asked John McCurdy, of the Bronx Union Y.M.C.A., New York, to form a committee for the purpose of re-evaluating the aims and objectives of the physical education work in the Y.M.C.A.'s. The steps which were followed in this study were essentially as follows:

1. Formation of a central committee. This committee was both fairly representative (involving outstanding persons who were capable of representing fairly the points of view in the area or agency involved) and authoritative (the members consisted of the best that could be secured).

2. Preliminary meeting of the central committee to explain more fully the commission and the assignment of definite individuals to bring in data, printed matter, and ideas related to present status.

3. Meeting of the central committee to review all the data collected and to weed out of this a comprehensive picture of present status of the aims and objectives, this to be used as a basis to work from.

4. Other meetings were held at which time invited experts came and offered critical and constructive suggestions relative to new emphases which could be incorporated in the statement in view of changing conditions and the general multiplication of agencies.

5. Preparation of a study document for wider distribution. This document outlined the best statement which could be made at the time, putting this in form for criticism, and arranged so that the criticisms could be made directly opposite the original statement.

6. Distribution of document to experts in the field.

7. Careful editing of the replies and presentation to the central committee. Consensus step by step.

8. Presentation before a university seminar for critical analysis and approval of the procedures.

9. Preparation of report in final form.

THE SIGNIFICANCE OF VALUE CLUSTERS IN MAKING DECISIONS*

Held values, or "value clusters," modify one's point of view and, hence, the decision made. There are nine major theses which should be understood by all who do group deliberation:

1. Every proposal involves values, valuing—what we want, wish, prefer.

2. Any proposal having a bearing on other people comes to involve their values; it is in so far a proposal of social policy.

3. No single value of an individual or group stands in isolation; rather it is one of a cluster involving different aspects of living felt by the holder to have relationship.

4. The real and inherent relationship, consistency, and validity matter but slightly in any case as compared with the *felt* relationship and reliability.

5. An individual's value clusters taken as a group and in proportional weighting constitute his psychological basis of security; to expect him to relinquish lightly strategic values in a cluster is undiscerning and unrealistic.

6. Changing one value tends to change somewhat the others in the value cluster.

7. Attack on the value most significant to the end desired may or may not be the most strategic attack on the situation.

8. Valuing stresses the "feeling" aspect, but this is not divorced from the "seeing" aspect; insight and emotion are closely related.

9. Valuing may be made more intelligent by introducing more insight.

PROMOTION OF IDEAS IN THE GROUP DISCUSSION

The chairman, or any member in a discussion group, can promote ideas effectively. Below are a few of the more pertinent suggestions related to this process:

1. Stressing common understandings and beliefs, rather than accentuating differences; by letting the group see wherever and how far he holds to their values even though he is working for them in a different way.

2. Guarding against dogmatism in his dealings with them, letting him see his willingness to change wherever study shows it to be desirable.

3. Helping them to see inconsistencies or conflicts in ideas or values now cherished.

4. Showing the inadequacy of the old to meet the need it is expected to meet.

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* From a paper developed by Miss Ostrander, secretary to Dr. Kilpatrick, Teachers College, Columbia University.

5. Studying with them some of the misconceptions on which opposition is based.

6. Taking care not to cut across too many values at one time.

7. Building sensitivity to the social need.

8. Helping them to see the relationship of their present held ideas to confused social conditions.

9. Helping them to see the consequences of the now-held values on the lives of others.

10. Working at the building of feeling of responsibility for such consequences.

11. Building toward a new value-insight which integrates many now-held values with a new and more justifiable concern.

12. Helping to cultivate another source of security on the new basis.

The above aspects are similar to "salesmanship" psychology as applied in the business world. The method is justifiable under conditions which permit the "open-minded" attitude to exist. The method is unjustifiable when the effort centers on selling fallacious ideas, unworthy projects, or other falsities.

IMPROVING THE METHODOLOGY FOR GROUP THINKING RESEARCH

There is need for much greater experimentation with the group thinking method as a method of research. It must be used beyond doubt as the most effective method to solve certain types of problems. How can it be improved so that there will be greater precision or accuracy in the results? We might say satisfaction with the results, since subjective data cannot be measured. The need here is:

1. To study the mechanics of the set-up so as to get:

a) The best experts to thinking.

b) The most accurate record of their thoughts.

c) The most expert editing of their agreements and disagreements with interpretation.

2. To study the process of thinking itself through the medium of logic to understand better:

a) The thinking related to normative principles (relations which exist).

b) The type of thinking in the deliberative process itself.

c) The mental process related to evaluational judgment of facts.

d) The type of thinking related to formulation or promotion of a cause.

e) The type of thinking which is related to description.

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Achievement Tests in Field Hockey for College Women

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An attempt has been made in this study to evolve objective tests in field hockey to serve as an aid in determination of the status of students regarding need for further requirement in field hockey and to facilitate classification into homogenous groups for instructional purposes.

PROCEDURE

Study of the Literature.—A study was made of tests from the following sources: Armfield,[1]* Cubberly,[2] Bartley,[3] Hillas and Knighton,[4] Howland,[5] Lucey,[6] and Maris.[7] Because none of these tests met our needs, we decided to construct tests, administer them to all available subjects, and then compare the results with subjective ratings to determine the extent to which our tests measured playing ability.

Selection of Test Items.—The skills included were selected on the basis of the subjective opinions of three nationally rated umpires as to the frequency with which they are used by college women in the game itself. Tests† were constructed in the following skills and combination of skills:

1. Dribble, dodge, circular tackle, and drive
2. Drive for goal (straight, to right, to left)
3. Fielding and drive
4. Push pass
5. Drive for distance
6. Receiving ball from team mate (left and right)

Subjects.—The fifty-one subjects used in this study represent all those available for testing during the fall season of 1938–39 from the general college and physical education major classes at the State University of Iowa and from the Iowa City Field Hockey Club. An attempt was made to obtain as wide a range in ability as possible.

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* Refer to numbered Bibliography at end of article.

† For description of tests and directions for administering them, see appendix. For interpretation of field hockey terms, see the official field hockey rules.

Criteria.—Subjective ratings were given by three nationally rated umpires, all of whom are players and teachers of considerable experience. The judges were asked to rate the players on general hockey playing ability during two successive periods and to classify them into five groups: 1, superior; 2, above average; 3, average; 4, below average; 5, inferior. The rating of the instructor of each particular group involved was weighted so that the criterion consisted of twice the instructor's score plus the sum of the other two raters. The criterion scores ranged from four, which was highest, to seventeen, which was the lowest.

TREATMENT OF DATA AND RESULTS

The coefficient of contingency [8]of the reliability of the criterion was .665.

An effort was made to determine: (1) the single test which was statistically best and which was most economical in time, and (2) the best combination of tests as determined by the results of multiple correlations. The scores of the six tests were analyzed by computing zero order, partial, and multiple correlations with the criterion.

From the results of the zero order correlations with the criterion, the rank of tests is as follows:

1. Fielding and drive, .4846
2. Goal shooting combined (straight, right, left), .4760
3. Push pass, .4604
4. Goal shooting left, .4433
5. Dribble, dodge, circular tackle, and drive, .4390
6. Drive for distance, .4179

The rank of test reliabilities (stepped up by application of the Spearman-Brown prophecy formula) is as follows:

1. Dribble, dodge, circular tackle, and drive, .9238
2. Combined goal shooting, .9189
3. Fielding and drive, .9010
4. Goal shooting left, .8700
5. Drive for distance, .8165
6. Push pass, .6755

Receiving the ball from left and from right were eliminated from further statistical treatment because of low reliabilities.

Statistically, the best single test is fielding and drive or combined goal shooting. The difference in the reliabilities of these two tests may easily be due to chance as the standard error is .02.

The most economically administered, all-round, single test is the dribble, dodge, circular tackle, and drive, which has a reliability of .9238 with a standard error of .02 and a validity of .4390. This test has relatively high intercorrelations (see Table I) with most of the other tests, indicating that it includes the elements in most of the tests.

TABLE I

INTERCORRELATIONS

Test	1	2	3	4	5	6
Criterion	.4433	.4390	.4846	.4179	.4760	.4604
1		.3894	.2165	.3430	.9191	.1921
2	.3894		.4584	.4255	.5037	.1606
3	.2165	.4584		.5598	.3870	.2033
4	.3430	.4255	.5598		.4639	.0310
5	.9191	.5037	.3870	.4639		.2324
6	.1921	.1606	.2033	.0310	.2324	

Test 1—Goal shooting left
Test 2—Dribble, dodge, circular tackle, and drive
Test 3—Fielding and drive
Test 4—Drive for distance
Test 5—Combined goal shooting
Test 6—Push pass

TABLE II

MEANS AND STANDARD DEVIATIONS

Test No.	Test Description	Mean	S.D.
0	Criterion	9.45	3.21
1	Goal shooting left	9.54	2.42
2	Dribble, dodge, circular tackle, and drive	24.56	3.38
3	Fielding and drive	6.99	2.35
4	Drive for distance	59.05	3.03
5	Combined goal shooting	25.39	2.86
6	Push pass	44.88	3.00

Multiple correlations were made to determine the combination which correlated best with the criterion and to determine the optimum weightings for the variables in these combinations. The relative importance of each item is indicated by the size of the regression beta weightings, as shown in Table III.

The best combination of two tests is the combination of the goal shooting left and fielding and drive tests with an r of .5958.

When the dribble, dodge, circular tackle, and drive is added to goal shooting left and fielding and drive tests, the multiple correlation is raised to .6161, an increase of only .0330 to the combination of two tests. The addition of drive for distance to the preceding three tests increased the correlation to .6275, which also is not an appreciable increase.

CONCLUSIONS

1. Of the tests in this study, it appears that the best single test for classification of college women in field hockey is the dribble, dodge, circular tackle, and drive test.

2. The best combination of two factors as determined by multiple correlations is the goal shooting left and the fielding and drive tests.

These two tests measure quite different things as is indicated by the low intercorrelation of .2165.

3. The dribble, dodge, circular tackle, and drive test, used in combination with a test of knowledge, should serve adequately for early season classification.

TABLE III

MULTIPLE CORRELATIONS AND BETA WEIGHTINGS

Multiple Correlations	Beta Weightings	Regression Equation
$R_{0.13} = .5958$	$B_1 = .3551$	$x_0 = .4687x_1 + .5544x_3 + 1.1035$
	$B_3 = .4077$	$x_0 = .47x_1 + .55x_3 + 1.10$
$R_{0.123} = .6161$	$B_1 = .2913$	$x_0 = .3825x_1 + .4764x_3 - 1.6182$
	$B_2 = .1717$	
	$B_3 = .3503$	$x_0 = .38x_1 + .17x_2 + .48x_3 - 1.62$
$R_{0.1234} = .6275$	$B_1 = .3038$	$x_0 = .4010x_1 + .1638x_2 + .4368x_3$
	$B_2 = .1689$	$+ .0530x_4 - 4.5812$
	$B_3 = .3213$	
	$B_4 = .0505$	$x_0 = .40x_1 + .16x_2 + .44x_3 + .05x_4 - 4.58$

0—Criterion
1—Goal shooting left
2—Dribble, dodge, circular tackle, and drive
3—Fielding and drive
4—Drive for distance
5—Combined goal shooting
6—Push pass

4. The writers would like to see this study continued further under the following conditions:

a) Secure a larger number of cases from a wide area and establish norms for high school players, college players, and club players, for the better tests.

b) Work on a test of changing directions in running as this seems to be an important item in field hockey.

c) Experiment with the push pass test to see what could be done to raise its reliability. The loss of time in getting another ball may be sufficient penalty without deduction of point.

d) Experiment with the dribble, dodge, circular tackle, and drive test to discover the optimum distance between the two obstacles. The present distance of ten feet is difficult for the novice.

e) Experiment with the drive for distance to see the effect of progressively decreasing the size of the area in proportion to the distance from the starting line under the theory that it becomes increasingly more difficult to better one's score after one has reached a certain degree of perfection.

f) Experiment with all the tests to discover the minimum number of trials needed to give acceptable reliability.

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APPENDIX

Standardized Directions for Administering the Tests.—One practice trial shall be given in each of the tests. Necessary equipment shall include: a smooth, closely cropped field in good condition; lines two inches wide, made with lime, wherever needed as indicated in the description of tests; as many regulation hockey balls as are specified in each test; regulation hockey sticks; two regulation jumping standards; unobstructed wall space at least 2 feet high and 10 feet wide with no floor moulding; and a wooden target 2 inches wide, 12 feet long, and ½ inch thick.

DESCRIPTION OF TESTS *

Test One: Dribble, Dodge, Circular Tackle, and Drive

Equipment.—

1. Hockey stick for each participant.
2. Stop watch, checked by a jeweler.
3. One ball necessary; two balls convenient.
4. High jump standards.
5. Field markings (see Figure I):

a) A line 20 feet long to be used for a starting line.

b) A line perpendicular to the midpoint of the starting line and extending 35 feet from it. This is the foul line.

c) A line 10 feet long, perpendicular to and being bisected by the foul line at a point 30 feet from the starting line. This is the restraining line.

d) A line 1 foot long, perpendicular to and being bisected by the foul line at a point 35 feet from the starting line.

e) Two lines, each 1 foot long, bisecting each other at a point which is 45 feet from the starting line and in a straight line with the foul line.

6. Position of standards:

a) One standard is placed so that the middle of the base of the standard is directly over the point where the foul line and the line described in 5*d* bisect each other.

b) The other standard is placed in similar fashion over the point formed by the two lines described in 5*c*.

* To save space, the descriptions of the push pass test, drive for distance test, and receiving from teammate have been omitted. They may be obtained by writing Esther French, Women's Gymnasium, State University of Iowa, Iowa City.

Test.—The player being tested shall stand behind the starting line with the hockey ball placed on the starting line at any point to the left of the foul line. At the signal "Ready? Go!" the player shall dribble the ball forward to the left of and parallel to the foul line. As soon as the restraining line is reached, the ball shall be sent from the left side of the foul line to the right of the first obstacle (from the player's point of view), and the player shall run around the left side of the obstacle and recover the ball. (This is analogous to a dodge.) Next, the player shall execute a turn toward her right around the second obstacle, still keeping control of the ball. (This is analogous to a circular tackle.) As soon as possible after that the ball shall be driven toward the starting line. If the drive is not hard enough to reach the starting line the player may follow it up and hit the ball again.

This procedure shall be repeated until six trials have been given, care being taken that no player is fatigued.

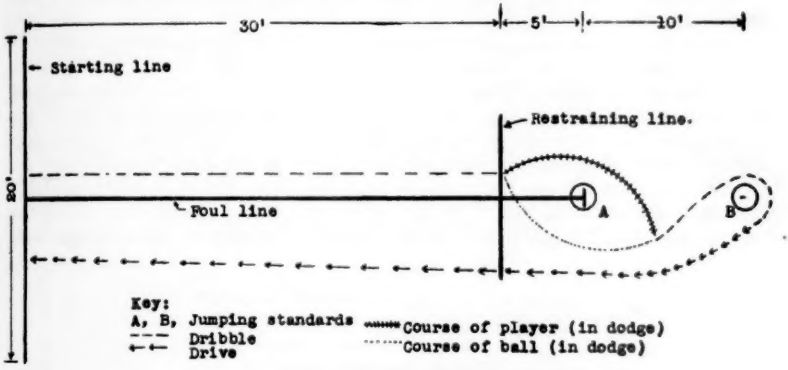

FIG. I. Field markings for test one.

Scoring—The score for one trial shall be the time it takes from the signal "Go" until the player's ball has again crossed the starting line. The score for the entire test is the average of the six trials. It is considered a foul and the trial does not count if:

1. The ball or player crosses the foul line before reaching the restraining line.
2. In executing the dodge, the ball is not sent from the left side of the foul line.
3. The player makes "sticks."

TEST TWO: GOAL SHOOTING—STRAIGHT, RIGHT, LEFT

Equipment.—

1. Target, 9 inches wide, 12 feet long, and at least ½ inch thick, made of hard wood.

The board is painted according to the following specifications: The length of the board is divided into eleven equal spaces, alternate spaces starting from either end being painted black and the other remaining the natural color of the wood. Numbers are painted in the spaces in contrasting colors (black on light background and white on black background) in the following order starting from either end: 1-2-3-4-5-6-5-4-3-2-1 (See Figure II).

A base made of board at least 3 inches wide, exactly 12 feet long, and at least ½ inch thick, is nailed on the bottom of the target so that two and one-half inches extend beyond the back of the target. The board, in order to stand upright securely, may be anchored with an ice pick or other similar device.

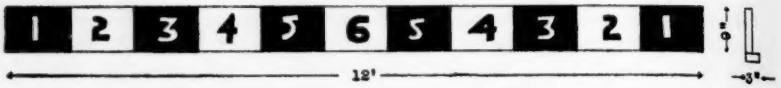

FIG. II. Front and side views of target for test two.

2. Same as *1* and *2* in test one.

3. At least four balls necessary; ten balls convenient.

4. Field markings (see Figure III):

a) A line 6 feet 6 inches long to be used for a starting line.

b) A rectangle 11 feet long and 6 feet 6 inches wide, 15 feet from the starting line. Point *A* is the midpoint of the side opposite the starting line.

c) A line 12 feet long, called the center target line, parallel to and 60 feet from the starting line.

d) A line 12 feet long, called the right inner target line (see Figure III).

e) A line 12 feet long, called the left inner target line.

5. Position of target: The target is placed directly on the specified line with the numbers facing the starting line and the board anchored with ice picks. For the straight drive, it is placed on the center target line, for the drive from right and left inner's positions, the right and left inner's target lines, respectively.

Test.—1. Drive from the Center's Position. The player being tested shall stand behind the starting line with the hockey ball placed directly on the starting line. At the signal "Ready? Go!" the ball shall be dribbled to the rectangle, from

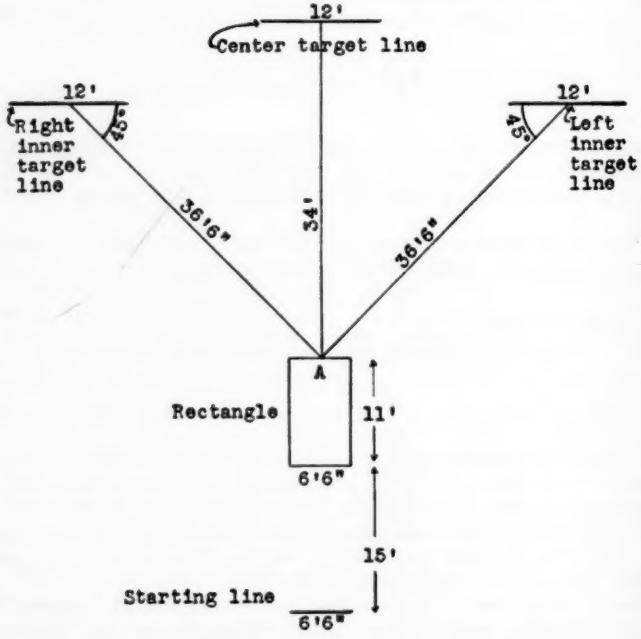

FIG. III. Field markings for test two.

within which area it must be driven toward the board (placed on the center target line). This procedure shall be repeated until ten trials have been given.

2. Drive from Right Inner's Position. The same procedure shall be repeated, the only difference being the position of the board, which is placed on the right inner target line.

3. Drive from Left Inner's Position. The same procedure shall be repeated, the only difference being the change in position of the target to the left inner target line.

Scoring.—The score for one trial shall constitute the time elapsing from the timer's signal "Go!" until the ball strikes the board. The score for the entire test is the sum of the first and second best odd and first and second best even numbered scores made on the center drive, the right inner drive, and the left inner drive. The score shall count if the ball bounces over the top of the target. In this case, the time shall be taken until the instant that the ball clears the target. Player shall receive a score of zero on a trial if:

1. The ball is not driven from within the rectangle.
2. The driven ball fails to reach the board or misses it at either end.

The attempt is not counted as a trial if:

1. "Sticks" are made.
2. Player raises the ball so that it doesn't touch the ground before it passes over the target.

Test Three—Fielding and Drive

Equipment.—

1. Same as for *1* and *2* in test one.
2. At least three balls necessary; seven or eight balls convenient.
3. Two ice picks with brightly covered tops.
4. Regulation hockey goal, including goal line and striking circle.
5. Special field markings (see Figure IV):

a) "Goal line" that is referred to is the line between the two goal posts. Midpoint of the goal line is referred to as point *B*.

b) Foul line, 12 feet long, parallel to and 10 feet from the goal line.

c) Restraining line, 30 feet long, parallel to and 10 feet from the foul line.

6. Each ice pick is placed on the foul line at a point directly opposite each goal post.

Test.—The player being tested shall stand behind the goal line. The examiner shall stand at the edge of the striking circle directly in front of the goal with a hockey ball in one hand and a stop watch in the other. At the examiner's signal "Ready? Go!" the hockey ball is rolled toward the goal at approximately the speed of 45 feet in 1.7 seconds. Simultaneously, the player shall run forward and attempt to field the ball before it reaches the foul line, tap it once, and drive it out of the striking circle from within the area between the restraining line and the foul line. This procedure shall be repeated until sixteen trials have been given.

Scoring.—The score for one trial is the time from the moment the player first touches the hockey ball to the moment the ball reaches the striking circle. The score on the entire test is the sum of the average of the three best even and three best odd numbered scores of the sixteen trials.

The attempt does not count as a trial if:

1. The rolled ball does not pass between the two ice picks.
2. The rolled ball is not delivered at approximately the speed designated.
3. The player makes "sticks."

The player receives no score on a particular trial if:

1. The ball is advanced illegally.

2. The ball rolls wholly over the foul line before or after it is touched by the player's stick.

3. The ball is not driven out of striking circle from within the area bounded by the restraining line and foul line.

4. The ball is not controlled; that is, stopped, tapped, and driven.

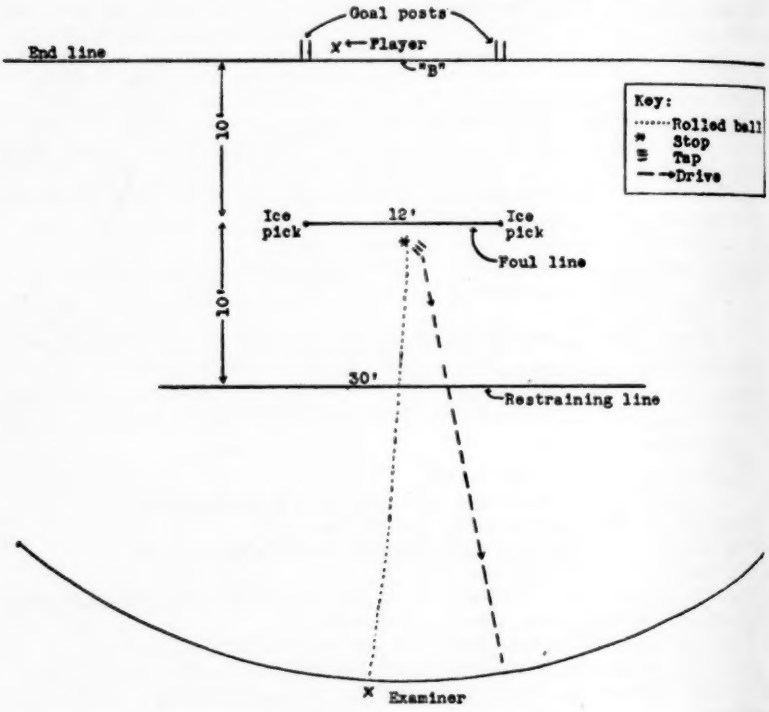

FIG. IV. Field markings for test three.

Practices Pertaining to Health and Physical Education in Secondary Schools

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IN ATTEMPTING to appraise, direct, and improve the individual program in health and physical education, teachers and administrators often feel the need of information pertaining to trends and desirable practices in other schools.

This report presents the results of a survey of practices pertaining to health and physical education in a representative group of schools. Although the questionnaire used in obtaining the information was quite lengthy and detailed only those items considered of basic importance are included here.

Replies to the questionnaire were received from 77 schools representing 21 states. The distribution of states was such as to make the returns representative of the entire country. The number of students enrolled in the 77 schools ranged from 100 to 7600. The following number of grades were reported and included in the study: seventh, 15; eighth, 18; ninth, 64; tenth, 74; eleventh, 72; and twelfth, 69.

In order to make significant comparisons regarding trends and practices, reference is made at frequent intervals to the survey of health and physical education[1] and intramural and interscholastic athletics[2] made by P. R. Brammell. The schools included in the comprehensive survey made by Brammell were selected as having outstanding programs and promising innovations in the field of health and physical education. The major purpose of the study was to show the direction in which the schools most active in the field were moving.

PART I. PHYSICAL EDUCATION

Organization for Physical Education in the 77 Secondary Schools.—Of the 77 schools reporting, 33 or 42 per cent stated that they had a chairman or director of physical education including intramurals, interscholastic athletics, and physical education for women; 53 or 69 per

[1] *Health and Physical Education.* National Survey of Secondary Education, Bulletin No. 17, Monograph No. 18, U.S. Gov't. Printing Office, 1933.
[2] *Intramural and Interscholastic Athletics.* National Survey of Secondary Education, Bulletin No. 18, Monograph No. 27, U.S. Gov't. Printing Office, 1933.

cent reported physical education for boys and girls organized separately; 15 or 19 per cent indicated a director of athletics apart from physical education; and 7 or 9 per cent showed a director of intramurals apart from physical education.

Since a number of schools checked more than one type of organization it is evident that a combination of types is frequently employed. A check revealed that the most common combination is that of having a director of health and physical education for boys including intramurals and interscholastic athletics with a department of physical education for girls organized separately. Eleven schools reported this type of combination.

In Brammell's report he states that "an outstanding trend among the schools is the tendency to place under a single administrative head all physical activities fostered." [3] Brammell's report showed that 52 per cent of the schools had a director of health and education. In the present study only 42 per cent reported this type of organization. This would seem to indicate that either the schools in the present study had not progressed as rapidly as the schools surveyed by Brammell or that the trend is away from the director type of organization. However, further consideration of the replies showed that there exists perhaps but little difference among the schools with respect to this organization. In the present study 15 of the 77 schools provide separate facilities for boys and girls. Thirteen of the 15 schools having separate facilities reported a separate organization for boys and girls. The use of separate facilities for boys and girls usually necessitates separate organizations. Furthermore, of the 68 schools reporting enrollment in this study, 24 were considered small schools[4] and 44 large. Of the 24 small schools, 67 per cent did not employ the director type of organization. This is logical in that the smaller schools with only two, three, or four physical education teachers may be administered successfully without a director of physical education. Of the 44 large schools, 52 per cent were organized under a director of physical education. This was compatible with the findings of Brammell.

Requirements, Frequency of Class Meetings, and Length of Class Periods.—A study of Table I shows that a large majority of the schools require physical education in grades seven, eight, nine, and ten. Apparently there is a tendency to begin waiving the requirement in grade eleven and in grade twelve it has declined until only 60 per cent of the schools require physical education work.

In frequency of class meetings Table I shows two periods per week to be predominant in all grades followed in order by three, five, one, and four class meetings per week. This is in harmony with Brammell who

[3] *Op. cit.*, p. 97.

[4] For purposes of comparison the schools were arbitrarily classed as large and small. Those having an enrollment of 700 and under were considered small; those over 700 as large.

found two class meetings per week ranking highest followed in order by five, four, three, and one period per week.

The length of class periods ranges from 40 to 60 minutes in all grades. The 45- and 60-minute periods seem most popular. The length of physical education class periods in the schools evidently are dependent on the length of class periods set for academic classes.

The requirements, frequency of class meetings, and length of class periods for girls are practically the same in every grade as that shown for boys.

TABLE I

GRADES IN WHICH PHYSICAL EDUCATION FOR BOYS IS REQUIRED, WITH FREQUENCY OF CLASS MEETINGS AND LENGTH OF CLASS PERIODS

Grade	Per Cent of Schools		Class Meetings Per Week					Average No. Minutes Per Class Period
	Required	Elective	1	2	3	4	5	
			Per Cent of Schools					
7	100	0	21	42	14	8	14	53
8	94	5	12	53	18	6	12	54
9	98	2	3	50	27	3	16	52
10	92	8	3	56	25	3	14	52
11	80	20	11	54	21	2	11	52
12	60	40	12	56	19	2	11	51

Opinions Regarding the Program of Physical Education.—Table II presents the opinion of those filling out the questionnaire regarding important phases of the physical education program. A check of the 33 schools stating that the time given to physical education was adequate shows that 23 require physical education from 3 to 5 periods a week. Of the 43 schools stating that the time given to physical education is inadequate, 40 require 3 periods or less a week. Only 11 of the 43 schools require 3 periods a week and 27 require it 2 periods weekly. Obviously, the amount of time given to physical education is conditioned by limited facilities and a lack of sufficient staff members, since 57 per cent of the schools stated that limited facilities affected the amount of time. Forty-two per cent stated that a lack of teachers to handle the work handicapped the program.

Facilities and Equipment.—Replies to the question asking the amount of space available for playgrounds exclusive of interscholastic athletics reveal a range from 7 schools having no space whatever to one school having 200 acres. The average amount of playground areas is 4.4 acres.

The amount of space available for interscholastic athletic fields ranges from 3 schools having no space to one having 30 acres. The average is 6.4 acres. Although, in many schools, the school site is insufficient

TABLE II

REPLIES TO QUESTIONS REGARDING PROGRAM OF PHYSICAL EDUCATION

Questions	Yes		No	
	No.	%	No.	%
Do you consider the time given to physical education adequate?	33	43	43	57
Do you think physical education should be required in all grades?	69	90	8	10
Is the amount of time allotted to physical education limited by a lack of facilities?	43	57	33	43
Is the amount of time allotted to physical education limited by a lack of teachers to handle the work?	31	42	42	58
Where conditions permit, do you think it desirable to require physical education daily in all grades?	51	68	24	32
Are students required to take shower baths following physical education periods?	60	79	16	21

in size to care properly for physical education and athletics, the trend seems toward the acquiring of greater areas by the schools. That school officials are aware of the needs of space for physical activities is shown in a recent volume by Koos, Reavis, Hughes, and Hutson.[5] They state that in a study of 17 school sites selected before the year 1900 the original area was 3.17 acres. These original sites have been added to from time to time until at present they have an average size of 10.48 acres.

In 17 school sites selected between the year 1917 to 1936, the average area of the original site was 24.3 acres. These sites have been increased by an average of 1.7 acres.

Fifty-four schools reported available tennis courts. Fifteen did not have access to tennis courts. Table III shows that clay and concrete courts are most popular.

TABLE III

SURFACING OF TENNIS COURTS

Kind of Surfacing	Number of Schools
Clay	28
Concrete	22
Grass	2
Asphalt	5
Stone	2

Table IV shows the number and size of gymnasiums. Those 60′ by 90′ and above are considered large. Medium-sized gymnasiums are

[5] L. V. Koos, W. C. Reavis, J. M. Hughes and P. W. Hutson, *Administering the Secondary School* (New York: American Book Co., 1940), 496–97.

those with minimum dimensions of 40′ by 60′. Those below 40′ by 60′ are classed as small.

Judging from the number of schools having large gymnasiums and often having access to more than one, the trend is moving rapidly toward the provision of suitable gymnasium facilities.

TABLE IV

NUMBER OF LARGE, MEDIUM, AND SMALL GYMNASIUMS AVAILABLE

Number of Large (60 x 90)	Number of Schools	Number of Medium (40 x 60)	Number of Schools	Number of Small	Number of Schools
1	39	1	33	1	9
2	9	2	10	2	4
3	3	3	1	3	1

Table V presents the answers to questions pertaining to facilities and equipment. A majority of the schools do not have sufficient locker room space. Also, shower baths are inadequate.

TABLE V

REPLIES TO QUESTIONS PERTAINING TO FACILITIES

Questions	Yes		No	
	No.	%	No.	%
Are your locker rooms well lighted and ventilated?	55	72	21	28
Do you consider your locker room space sufficient?	35	45	42	55
Do you have sufficient showers for all students?	42	59	29	41
Do you consider your facilities (playgrounds, athletic fields, gymnasium space, etc.) adequate?	15	21	57	79
Do you consider your equipment (balls, bats, mats, etc.) adequate?	65	88	9	12
Are your facilities and equipment shared by both boys and girls?	59	70	15	20

Content of the Physical Education Program.—Table VI reveals that the activities in the physical education program consist largely of sports. Basketball, softball, and volleyball rank highest in the total number of schools offering such activities.

Parts I and II of Table VII show the activities offered in the schools at the various grade levels for both boys and girls. It seems noteworthy that the team sports of basketball, softball, and volleyball which ranked highest among activities in the total program also ranked among the highest for both boys and girls at all grade levels.

TABLE VI

NUMBER AND PERCENTAGE OF THE SEVENTY SCHOOLS REPORTING AS OFFERING THE VARIOUS ACTIVITIES LISTED IN THE PHYSICAL EDUCATION CURRICULUM

Activities	All Schools		Large Schools*		Small Schools	
	No.	%	No.	%	No.	%
Basketball	65	93	34	87	23	100
Softball	63	90	34	87	22	96
Volleyball	62	89	33	85	21	91
Tumbling	59	84	32	82	19	83
Calisthenics	55	79	33	85	16	70
Track and field	52	74	29	74	15	65
Relay racing	51	73	28	72	15	65
Group games	49	70	25	64	17	74
Touch football	49	70	23	59	18	78
Marching	47	67	30	77	12	52
Folk dancing	45	64	24	62	15	65
Badminton	42	60	26	67	12	52
Table tennis	42	60	24	62	13	56
Rhythms	40	57	22	56	14	60
Soccer	35	50	14	36	16	70
Social dancing	33	47	13	33	16	70
Deck tennis	31	44	16	41	10	43
Apparatus (formal)	29	41	19	49	6	26
Tap or clog dancing	29	41	13	33	12	52
Combative contests	28	40	18	46	6	26
Tennis	27	39	20	51	12	52
Boxing	26	37	13	33	9	39
Archery	25	36	15	38	9	39
Modern dance	24	34	14	36	7	30
Swimming	24	34	17	44	5	22
Lifesaving	23	33	15	38	5	22
Wrestling	22	32	10	26	8	35
Field hockey	20	29	10	26	6	26
Golf	19	27	14	36	4	17
Paddle tennis	18	26	10	26	4	17
Baseball	19	24	11	28	7	30
Exercises with apparatus (wands, dumbbells, etc.)	16	23	13	33	3	13
Handball	16	23	13	33	1	4
Speedball	12	17	7	18	3	13
Ice skating	10	14	6	15	4	17
Bowling	9	13	6	15	3	13
Winter sports	7	10	2	5	5	22

* The 70 schools reporting activities were roughly classed as large and small. Schools having an enrollment over 700 were classed as large; those under 700 as small. Eight schools failed to cite enrollment; therefore, they could not be used in determining the percentages for large and small school activities.

TABLE VII

NUMBER AND PERCENTAGE OF SCHOOLS REPORTING AS OFFERING THE VARIOUS ACTIVITIES LISTED AT THE DIFFERENT GRADE-LEVELS

I. BOYS

	Grade 7		Grade 8		Grade 9		Grade 10		Grade 11		Grade 12	
Activities	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Apparatus (formal) ...	1	8	2	14	15	26	21	32	18	28	15	24
Archery	0	0	0	0	3	5	7	11	9	14	9	14
Badminton	2	17	2	14	9	16	13	20	10	15	10	16
Baseball	3	25	3	21	8	14	10	15	12	18	11	17
Basketball	9	75	11	79	43	75	53	80	45	69	37	59
Bowling	0	0	0	0	1	2	1	2	1	2	1	2
Boxing	2	17	2	14	14	25	22	33	16	25	13	21
Calisthenics (formal) ..	8	67	9	64	32	56	37	56	32	49	27	43
Combative contests	6	50	8	57	23	40	22	33	18	28	14	22
Deck tennis	2	17	2	14	6	11	5	8	4	6	2	3
Exercises with app. ... (wands, dumbbells, etc.)	1	8	2	14	8	14	10	15	8	12	7	11
Field hockey	0	0	0	0	0	0	0	0	0	0	0	0
Folk dancing	0	0	0	0	0	0	0	0	0	0	0	0
Golf	0	0	1	7	6	11	8	12	11	17	11	17
Group games	8	67	11	79	34	60	36	55	29	45	23	37
Handball	4	33	4	29	11	19	10	15	8	12	9	14
Lifesaving	2	17	2	14	5	9	10	15	5	8	4	6
Marching	7	58	9	64	27	42	28	42	25	38	20	32
Modern dance	1	8	2	14	5	9	4	6	3	5	3	5
Paddle tennis	2	17	2	14	7	12	5	8	6	9	5	8
Relay racing	8	67	9	64	32	56	36	55	26	40	21	33
Rhythms—dancing	1	8	1	7	5	9	5	8	4	6	3	48
Ice skating	2	17	2	14	5	9	6	9	6	9	6	10
Social dancing	2	17	3	21	6	11	10	15	6	9	6	10
Soccer	7	58	7	50	17	30	15	23	12	18	11	17
Softball	10	80	12	86	37	65	46	70	37	57	33	52
Swimming	3	25	3	21	8	14	14	21	10	15	8	13
Table tennis	4	33	3	21	15	26	21	32	18	28	18	29
Tap or clog dancing	0	0	0	0	1	2	3	5	3	5	3	5
Tennis	3	25	4	29	13	23	15	23	16	25	17	27
Touch football	10	80	10	71	36	63	40	61	30	46	27	43
Track and field	10	80	11	79	35	61	40	61	32	49	26	41
Tumbling	8	67	9	64	35	61	42	64	34	52	30	47
Volleyball	5	42	9	64	31	54	40	61	36	55	29	46
Winter sports	0	0	0	0	4	7	4	6	4	6	4	6
Wrestling	1	8	2	14	14	25	19	29	14	22	14	22
Speedball	2	17	2	14	3	5	5	8	5	8	2	3

TABLE VII (Cont'd)

II. GIRLS

Activities	Grade 7		Grade 8		Grade 9		Grade 10		Grade 11		Grade 12	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Apparatus (formal)	0	0	0	0	7	12	9	14	8	12	6	10
Archery	2	17	2	14	8	14	11	17	12	18	12	19
Badminton	3	25	5	36	18	32	21	32	17	26	16	25
Baseball	2	17	2	14	2	4	3	5	2	3	1	2
Basketball	7	58	10	71	35	61	43	65	37	57	30	48
Bowling	1	8	1	7	4	7	5	8	5	8	4	6
Boxing	0	0	0	0	0	0	0	0	0	0	0	0
Calisthenics (formal) ..	7	58	9	64	27	47	31	47	28	43	24	38
Combative contests	3	25	4	29	8	14	6	9	6	9	5	8
Deck tennis	6	50	8	57	17	30	21	32	17	26	14	22
Exercises with app. .... (wands, dumbbells, etc.)	0	0	1	7	5	9	6	9	4	6	5	8
Field hockey	3	25	3	21	11	19	13	20	12	18	10	16
Folk dancing	9	75	11	79	28	49	35	53	24	37	22	35
Golf	0	0	0	0	2	4	4	6	5	8	7	11
Group games	9	75	13	93	37	65	41	62	34	52	31	49
Handball	4	33	4	29	4	7	3	5	3	5	4	6
Lifesaving	1	8	3	21	5	9	6	9	6	9	6	10
Marching	6	50	8	57	25	44	28	42	25	38	21	33
Modern dancing	3	25	3	21	13	23	14	21	13	20	12	19
Paddle tennis	3	25	4	29	11	19	8	12	8	12	5	8
Relay racing	7	58	9	64	27	47	28	42	24	37	20	32
Rhythms—dancing	8	67	10	71	28	49	31	47	24	37	17	27
Ice skating	2	17	2	14	4	7	6	9	6	9	6	10
Social dancing	6	50	7	50	18	32	24	36	18	28	18	29
Soccer	3	25	3	21	19	33	19	29	17	26	14	22
Softball	8	67	11	79	33	58	39	59	34	52	30	48
Swimming	3	25	4	29	7	12	10	15	7	11	7	11
Table tennis	6	50	8	57	23	40	29	44	26	40	22	35
Tap or clog dancing ...	2	17	2	14	17	30	21	32	18	28	16	25
Tennis	5	42	5	36	17	30	16	24	21	32	20	31
Touch football	0	0	0	0	0	0	1	2	1	2	1	2
Track and field	6	50	7	50	13	23	13	20	11	17	8	13
Tumbling	8	67	10	71	24	42	28	42	19	29	16	25
Volleyball	10	80	12	86	32	56	39	59	32	49	25	40
Winter sports	0	0	0	0	4	7	5	8	5	8	5	8
Wrestling	0	0	0	0	0	0	0	0	0	0	0	0
Speedball	1	8	2	14	4	7	8	12	7	11	4	6

Interscholastic Athletics.—Table VIII discloses that 95 per cent of the schools participate in interscholastic basketball. Football ranks second and track and field third. Attention is called to the high percentage of schools participating in golf and to the comparatively low percentage participating in tennis. The natural assumption in regard to this information is that it is possible for schools to secure access to golf courses more readily than to tennis courts. This condition should be remedied for certainly if a community can maintain golf courses it can also maintain sufficient tennis courts for school use.

TABLE VIII

NUMBER AND PERCENTAGE OF THE 77 SCHOOLS PARTICIPATING IN THE VARIOUS INTERSCHOLASTIC SPORTS

	Boys		Girls			Boys		Girls	
	No.	%	No.	%		No.	%	No.	%
Baseball	45	58	..	..	Softball	14	18	13	17
Basketball	73	95	10	13	Speedball	2	3	3	4
Boxing	5	7	..	..	Six-man ftball	4	6	..	..
Cross country	21	27	..	..	Swimming	27	35	4	6
Field hockey	2	3	2	3	Table tennis	8	10	5	7
Football	69	90	..	..	Touch football	5	7	1	1
Golf	56	73	2	3	Track—field	68	88	5	7
Horse shoes	1	1	1	1	Wrestling	14	18	..	..
Ice hockey	5	7	..	..	Tennis	18	23	2	3
Rifle shooting	7	9	..	..	Bowling	2	3	1	1
Soccer	7	9	4	6	Gymnastics	2	3	1	1

A study of table IX indicates a desirable trend in the financing of interscholastic athletics. The trend seems to be in the direction of a pooling of resources to promote all activities within the school. A notable point is the high percentage of schools in which the maintenance of intramural athletics does not depend on gate receipts from interscholastic athletics.

TABLE IX

FINANCING INTERSCHOLASTIC ATHLETICS

	Yes		No	
	No.	%	No.	%
Interscholastic athletic program financed entirely by gate receipts	40	55	33	45
Gate receipts from interscholastic athletics are used to promote other school projects	34	46	40	54
Intramural program depends in part on gate receipts from interscholastic athletics	27	37	46	63

Question: Are students permitted to substitute participation on an interscholastic athletic squad for physical education class work? ....Yes, 52; No, 21

Question: Do ninth-grade students participate in interscholastic athletics? Yes, 62; No, 10

Intramural Programs.—Table X shows the number and percentage of schools maintaining intramural programs for the various grade levels throughout the autumn, winter, and spring seasons. It should be noted that there is no significant difference in the maintenance of intramural programs for boys and girls. Also, the total number of small schools is less than the large and the percentage of small schools maintaining programs at the various grade levels is frequently greater than that of the large schools.

Seventy per cent of the schools reported that limited play areas, facilities, and equipment are responsible for fewer numbers participating regularly in intramurals.

TABLE X

NUMBER AND PER CENT OF SEASONAL MAINTENANCE OF INTRAMURAL PROGRAMS OF THE 71 SCHOOLS REPORTING THAT INTRAMURALS ARE CONDUCTED

I. Autumn Season

	Boys						Girls					
	Total Schools		Small Schools		Large Schools		Total Schools		Small Schools		Large Schools	
Grade	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
7	13	87	6	46	7	54	11	73	5	45	6	55
8	16	89	7	44	9	56	14	93	6	43	8	57
9	40	68	23	57	17	43	38	64	22	58	16	42
10	52	75	23	44	29	56	48	70	22	46	26	54
11	51	76	22	43	29	57	47	70	21	45	26	55
12	46	72	20	44	26	56	43	67	19	44	24	56

II. Winter Season

7	12	80	6	50	6	50	11	73	5	45	6	55
8	15	83	7	47	8	53	14	78	6	43	8	57
9	43	73	25	58	18	42	42	71	23	55	19	45
10	54	78	25	46	29	54	50	73	23	46	27	54
11	52	78	24	46	28	54	49	73	22	45	27	55
12	47	73	22	47	25	53	46	72	20	44	26	50

III. Spring Season

7	12	80	6	50	6	50	11	73	5	45	6	55
8	15	83	7	47	8	53	15	78	6	43	9	57
9	43	73	25	58	18	42	41	70	23	56	18	44
10	54	78	25	46	29	54	51	74	23	45	28	55
11	53	79	24	45	29	55	50	75	22	44	28	56
12	48	75	22	46	26	54	46	72	20	44	26	56

Military Training in the Schools.—From a study of Table XI it is apparent that military training is not general among the schools. Neither is it used or considered a substitute for physical education by a large majority of the schools.

TABLE XI

MILITARY TRAINING

Questions	Yes	No
	Number of Schools	
Is military training offered	10	66
Is it compulsory	1	9
Grades in which military training is offered:		
Grades — *Number of Schools*		
Ninth — 7		
Tenth — 10		
Eleventh — 10		
Twelfth — 10		
Are students permitted to substitute military training for physical education class work?	8	2
Do you consider military training a desirable substitute for physical education class work?	7	31

Restricted Activity.—Table XII indicates that a large majority of the schools have progressed beyond the maintenance of formal corrective classes for postural defects. The trend seems toward adapted sports for physically handicapped students either in special form or by permitting students to remain in the regular physical education classes.

TABLE XII

RESTRICTED ACTIVITY

Questions	Yes	No
	Number of Schools	
Does your school maintain formal corrective classes for children with postural defects?	18	57
Does your school maintain a program of adapted activities (largely sports) for handicapped students including those with postural defects	22	55
Do the physical-education teachers adapt activities to handicapped children, permitting them to remain in the regular physical-education class?	60	9

PART II. HEALTH

Organization for Health Work in the Schools.—Table XIII shows that the health work in 49 of the 69 schools responding to the inquiry is organized as a part of the physical education program.

TABLE XIII

STATEMENTS THAT APPLY TO THE ORGANIZATION FOR HEALTH WORK IN 77 SECONDARY SCHOOLS

Questions	Yes	No
	Number of Schools	
Health work organized as a part of the physical education program	49	20
Health work organized as a single department under a director of health and physical education	13	38
Health work organized as a separate department under a special health director	9	39

Agencies of Which Health Work in Secondary Schools is a Part.—Although Table XIV shows that in a majority of the schools the responsibility for health work is assumed by the city school system, it is obvious that some schools make use of a combination of affiliations.

TABLE XIV

AGENCIES OF WHICH HEALTH WORK IN 77 SECONDARY SCHOOLS IS A PART

Agencies	Number of Schools
State Board of Health	13
State Department of Education	17
County Board of Health	9
County Board of Education	4
City Board of Health	18
City School System	45
Independent of any unit beyond your own school	15

Groups Cooperating in the Promotion of Certain Phases of Health Work.—Table XV shows that physical education, science, and home economics classes rank highest in the health instruction phase of health projects. Physical education classes are employed more than other departments or classes in the health service and in the supervision of health projects.

TABLE XV

GROUPS THAT CO-OPERATE IN CARRYING ON HEALTH PROJECTS, CONTESTS, AND THE LIKE IN CONNECTION WITH HEALTH SERVICE, HEALTH SUPERVISION, AND HEALTH INSTRUCTION

Groups	Health Service	Health Supervision	Health Instruction
	Number of Schools		
Homerooms	18	15	17
Science classes	15	9	59
Physical education classes	34	38	59
Home economics classes	17	17	60
Social studies	9	4	28
Clubs	7	7	12
Welfare department	1	1	..
Medical department	1	1	1
Clinics	1	1	1
Administration	2	3	1
Junior Red Cross	1	..	1

The Physical Examination of Students.—Table XVI reveals that a large number of the schools have made at least some provisions for the physical examination of students. The most popular requirements indicated are compulsory examinations periodically and compulsory examination when first enrolling. Apparently, the yearly examination is most frequently employed, since 24 schools specified the use of this period.

TABLE XVI

PHYSICAL EXAMINATION REQUIREMENTS FOR STUDENTS IN 77 SECONDARY SCHOOLS

Plan for Giving Physical Examinations	Number of Schools
Compulsory when first enrolling	25
Compulsory periodically	33
Optional when first enrolling	2
Optional at all times	13
Once during each school year	24
Twice during each school year	2
Once during entire secondary-school attendance	10

In Table XVII the items listed as included in the physical examinations are self-explanatory.

TABLE XVII

ITEMS INCLUDED IN THE PHYSICAL EXAMINATION OF STUDENTS

Items	Number Schools	Items	Number Schools
Eyes	64	Skin	61
Ears	66	Nutrition	4
Nose	66	Blood pressure	3
Throat	67	Feet	3
Teeth	61	Nervous system	3
Lungs	62	Posture	3
Heart	68	Glands	2
Orthopedic condition	48	Height and weight	2
Speech	24	T. B. test	2
Hernia	52		

According to Table XVIII, physicians are largely responsible for making the physical examinations of students. Nurses or physical education teachers obviously assist and, perhaps in some cases, make the examination.

TABLE XVIII

PERSONS MAKING EXAMINATIONS OF STUDENTS

Persons	Number of Schools
Physician	65
Nurse	32
Physical education teachers	21
Special health teachers	1

In reply to the question "Do women physicians make the physical examination for girls?" 46 of the 68 schools answered in the affirmative. In answer to the question "Are efforts made to follow up the correction of remediable defects?" 56 of the 61 answered affirmatively.

Program Adjustment to Individual Cases on the Basis of the Results of Physical Examination.—In reply to the question "Is the school program adjusted to individual cases on the basis of physical examinations when results show it to be necessary?" 67 or 90 per cent of the 74 answering stated that adjustments are made. The nature of the recognition of individual cases in this respect is shown in Table XIX. Judging from the large percentage of schools giving attention to seating, modified activities, rest periods, modification of class work, and modified programs of study, the results of physical examinations are extensively used.

TABLE XIX

PROVISIONS FOR THE RECOGNITION OF INDIVIDUAL DIFFERENCE ON THE BASIS OF THE RESULTS OF PHYSICAL EXAMINATIONS

	Schools	
	No.	%
Rest periods	46	62
Modified activities	63	85
Proper feedings	17	23
Modification of class work	45	61
Seating for eye and ear defects	59	80
Modified programs of study	43	58
Assignment to special classes	26	35
Assignment of home work	21	28

Other kinds of health service other than those previously mentioned are shown in Table XX. Obviously these types of health service are not particularly popular with the schools.

TABLE XX

KIND OF HEALTH SERVICE PROVIDED
(OTHER THAN THOSE PREVIOUSLY MENTIONED)

Kinds of Service	Number of Schools
Free milk for malnourished students	17
Home instruction for invalid students	13
Health instruction for parents	5
Health education lectures for parents and community	19

Health Instruction in the Schools.—A study of Table XXI reveals that physical education teachers lead in responsibility for definite organized health instruction in the secondary schools. Science teachers rank second and home economics teachers third. The large number of teachers of social studies, home economics, and science listed as giving definite organized instruction indicates health unit materials are common in these fields.

TABLE XXI

PERSONS WHO GIVE DEFINITE ORGANIZED HEALTH INSTRUCTION
(PERSONS DOING INCIDENTAL TEACHING NOT INCLUDED)

Persons	Number of Schools
Special health teacher	10
School nurse	26
School physician	9
Physical education teacher	55
Science teacher	40
Social studies teacher	9
Home economics teacher	36

Replies to inquiries regarding persons teaching courses in health education show that physical education teachers rank first with school nurses second.

TABLE XXII

PERSONS WHO TEACH COURSES IN HEALTH EDUCATION

Persons	Number of Schools
Physical education teachers	30
Nurse	9
Science teachers	6
Health teachers	2
All teachers	1
Football coach	1

Table XXIII shows the various secondary school courses in which health education units are offered. Biology, home economics, and general science are the courses most often utilized for health instruction.

TABLE XXIII

OTHER COURSES IN WHICH DEFINITE HEALTH-INSTRUCTION UNITS ARE TAUGHT

Courses	Number of Schools	Courses	Number of Schools
Biology	61	Social science	24
Physiology	22	English	2
General science	43	Physical education	1
Chemistry	17	Service club	1
Physics	3	Safety	1
Home economics	61	Shops	1
Agriculture	4	Nature study	1

CONCLUSIONS

Results of the survey of health and physical education in 77 secondary schools show:

1. A large percentage of the schools require physical education class work in all grades.

2. Two physical education class periods per week predominant in all grades.

3. The average size per school of playground area to be 4.4 acres exclusive of interscholastic athletic fields.

4. The number of students participating in physical activities limited by play areas and teachers. There is a definite trend toward the accumulation of greater play areas.

5. A large percentage of the schools maintain intramural programs although some did not maintain intramurals throughout the autumn, winter, and spring seasons.

6. The trend in providing restricted activity toward adapted sports.

7. That in a majority of the schools health work is organized as a part of physical education.

8. That a majority of the schools make some provisions for the physical examination of students.

9. Adjustment made for students when results of physical examinations show it to be necessary.

10. A majority of the schools offer a definite course in health instruction.

11. A majority of the definite health courses in the schools are taught by physical education teachers.

An Anthropometric Study of Negro and White College Women

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In A study on the growth of children of four racial groups, the senior author has shown that although the races may differ from one another in actual stature, the manner in which they attain their stature is very much the same.[1] Thus all male children between six and seven years of age of each of four races studied grow at a rapid rate. Between the ages of seven and eight this rate of growth diminishes slightly, and it continues to decrease until the average age of 10.5 years, when there is again an increase in the rate of growth for all races lasting until 14.5 years. At this time the rate of growth suddenly decreases. This means that at 10.5 years there is a minimum of growth for each race considered and at 14.5 there is a maximum of growth. This similarity of growth in four distinct races is of interest, especially since most studies of races emphasize racial differences.

That races differ from one another in certain physical characteristics is obvious to every observer. Most Negroes have a darker skin and more curly hair than members of the white race. Other differences, less obvious but still well known, show that whites have a relatively longer trunk than Negroes who, in turn, have relatively longer arms and legs. The Negro upper arm is generally conceded to be relatively shorter and the lower arm relatively longer than that of the white. His pelvis is generally narrower than that of the white. Differences in facial features and head form are also obvious. To review the physical differences between whites and Negroes already presented in the literature, the reader is referred to articles listed in the bibliography.[2]

The purpose of this paper is to present additional figures which show similarities and dissimilarities in the physical features of Negroes and whites.

MATERIAL AND METHOD

The Negro data were obtained at Tuskegee Institute, Alabama. One hundred girls from the physical education classes at the college

[1] Steggerda and Grant, 1938.
[2] Cobb, 1936; Hrdlicka, 1928; Todd and Lindala, 1928.

were selected at random by Mrs. C. E. Petty and were measured by M. Steggerda.[3] Mrs. Petty acted as recorder and plotted a pedigree of each girl to determine the degree of her race mixture. Nearly every girl measured told of some degree of white and Indian admixture. It is estimated, however, that the 100 girls measured have more Negro blood than they do white and Indian together. Thus the Negro population are at least 50 per cent Negro and very likely as much as 75 per cent Negro; there may be some 80 and 85 per cent pure Negro. The authors feel confident that in no case are any of the subjects 100 per cent Negro. The statistical work was done at Cold Spring Harbor. The data on white girls were obtained from a published paper on one hundred Smith College students.[4] In the main these girls represent a North European stock, all born in the United States.

The comparison between the two college groups is ideal, since the races under consideration are similar in several features. For example, the Negroes considered have an average age of $20.05 \pm .13$ years and the whites, $20.15 \pm .07$, ranging in each case from 17 to 24 years. This equality of age is of interest since both groups were selected at random from the regular college enrollment. The two groups are also comparable in stature and weight. Therefore, the physical differences and similarities shown in this paper have a real significance. The data are treated statistically, and the significance of the differences is shown for each dimension.

The measurements were made by the same person using consistently the same technique. All students were measured without shoes. The Smith College girls were measured over ordinary clothing, while the Tuskegee girls were measured in gym clothes.

Definitions of the anthropometric terms used and descriptions of the technique of measurement are supplied as follows: (the order follows more or less that found in Tables I, II, and III).

1. *Standing or Vertex Height.*—The distance from the highest point of the head to the floor. The measurement was made with an anthropometer devised by Martin.

2. *Weight.*—recorded in pounds from a balance scale. The figures were transferred to the metric system in the laboratory.

3. *Chest Girth.*—This was measured with the tape roughly perpendicular to the vertebral column at the level of the axilla. The subject neither inflated nor entirely emptied his lungs.

4. *Chest Depth.*—the distance from the anterior to the posterior regions of the chest, using the upper section of the anthropometer with straight arms as calipers. The anterior point of measurement was made

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[3] This paper was read and approved by Cleve L. Abbott, Director of Physical Education, Tuskegee Institute. For this service the authors express their thanks.

[4] Steggerda et al., 1929.

at the upper part of the breasts. The posterior point equaled the lowest point of the scapulae.

5. *Chest Transverse.*—This was the distance across the ribs, with the arms of the calipers pointed downward so as to come in contact with a number of ribs. The broadest distance, with the chest at rest, was considered to be the measurement.

6. *Chest Girth ÷ Stature.*—This is called relative chest girth.

7. *Hand Length and Breadth.*—The hand and elbow were laid flat on the table. The distance from the styloid process of the radius to the tip of the middle finger was used for hand length. The breadth of the hand was the broadest distance across the hand at right angles to the hand length.

8. *Calf Girth.*—Maximum girth of the leg below the knee, with the subject standing.

9. *Ear Length.*—The maximum length of the external ear.

11. *Biacromial Breadth.*—This is the shoulder width and is taken as the maximum distance between the two acromial processes.

12. *Acromial Height.*—This is the distance from the upper surface of the sharp edge of the acromial process to the floor. Care is taken that the shoulders are horizontal and that the arm is held immovable.

13. *Iliospinale Height.*—This is the distance from the lower margin of the right spine of the pelvis to the floor. This lower margin of the spine is easily located with the thumb of the left hand.

14. *Span.*—The subject stood with her middle finger touching a wall. She was urged to stretch her arms to the maximum distance. The anthropometer was placed behind the person at the level of the shoulders so that the zero end was near the middle finger against the wall. The longest distance was recorded as the span.

16. *Arm.*—The dimensions of the *arm* segments were obtained from the measurements called acromial, radial, and styloid height. The acromial height is explained in 12. The radial height is the space between the upper end of the radius and the lower end of the humerus. The styloid height is the distance from the distal end of the radius to the floor. *The total arm length* in this study is the distance between acromial height and stylion height. *Upper arm* equals acromial height minus radial height and *lower arm* equals radial height minus styloid height.

24. *Leg Length.*—In this study, leg length was determined by the method of Martin,[5] a subtraction being made from the iliospinale height. Thus, for individuals with statures from 131 to 150 cm., 20 mm. were subtracted from the iliospinale height; those 151 tc 165 cm. in stature, 30 mm. were subtracted; and those from 166 to 175, 40 mm.; and 176 and over, 50 mm. were subtracted.

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[5] Martin, 1928.

25. *Tibiale Height.*—This point was easily determined by requesting the individual to bend the knee and then feeling with the thumb nail the joint between the femur and tibia. This point, with subject standing erect, to the floor was considered the tibiale height.

28. *Head Length.*—One end of the calipers was placed at the glabella and held there with the fingers. The other hand manipulated the other end, to find the point on the occiput which was farthest from the glabella. The maximum reading on the scale was recorded as head length.

29. *Head Width.*—The observer stood in front of the individual, holding the instrument in a horizontal plane at the level of the maximum width of the skull. The tips of the calipers were moved so as to locate the broadest point, and this point was recorded as head width.

30. *Bizygomatic Breadth.*—The maximum reading on the scale of the sliding calipers was taken when the tips of the calipers were in contact with the skin over the two zygomatic arches.

31. *Trichion to Gnathion.*—The distance, in the vertical plane, between the hair line and the most projecting point of the jaw, just below the chin.

32. *Nasion to Gnathion.*—The distance from the nasion (upper end of nasal bone) to the most projecting part of the jaw, just below the chin.

33. *Nasion to Stomion.*—The distance between the nasion and the midpoint of the oral slit or mouth.

34. *Nasion to Subnasion.*—The distance between the nasion and the base of the nose. This dimension is also called the length of the nose.

36. *Nasal Breadth.*—The maximum breadth of the nose when the face is in a relaxed condition.

38. *Bigonial Breadth.*—This was taken as the greatest distance between the angles of the lower jaw. This and the bizygomatic breadth are dimensions of face width.

39. *Mouth Width.*—The maximum breadth of the mouth when the face is in a relaxed condition.

40. *Ear Breadth.*—Greatest breadth of ear perpendicular to long axis.

42. *Sitting Height.*—The subject was seated in an erect position on a level table, the head being held in the Frankfort horizontal position (a line drawn from the tragus to the lower edge of the orbit must be parallel to the table). The measurement was taken at the back of the individual from the vertex of the head to the table, in the same manner as that of standing vertex height. The possible slight correction for clothes in recording this measurement was not considered.

43. *Intercristal Breadth* and *Interspinal Breadth.*—These measurements are not as accurate as might be desired, because of embarrass-

ment to the females in locating these points. The intercristal breadth was the broadest distance between the wings of the ilia of the pelvis, while the interspinal breadth was the distance between the two points on the pelvis described under Number 13.

46. *Head Girth.*—Maximum girth of head with the tape passing over the glabella and inion.

53. *Frontal Breadth.*—The tips of the calipers were placed in the hollows of the frontal region above the orbits, and then drawn forward to the slight depression just before the frontal bends toward the front of the forehead. The minimum reading shown on the calipers, the tips remaining at the anterior margin of the hollows, was recorded as minimum frontal.

RESULTS

In Table I are shown those dimensions of Negroes and whites which are statistically similar. The stature of the 100 Negro girls is 163 cm. or 5 feet 4 inches. This not only compares statistically with the 100 white girls from Smith College but is likewise similar to 17,000 white college women as reported by Diehl, 1933. His figure was 162 cm. or 5 feet 3.75 inches. The Pembroke "Old American" College girls by Carter, 1932, average 164 cm. which is 5 feet 4.5 inches. There are

TABLE I

MEASUREMENTS WHICH FOR NEGROES AND WHITE COLLEGE GIRLS ARE SIMILAR.*

Measurement	Negro	White	Difference / P.E. of Dif.
1. Stature	1633.10 ± 4.55	1628.05 ± 3.75	0.86
2. Weight	55.84 ± .47	55.59 ± .41	0.40
3. Chest girth	803.90 ± 2.80	793.90 ± 2.47	2.68
4. Chest depth	191.00 ± .97	188.45 ± .74	2.09
5. Chest transverse	251.35 ± .98	250.70 ± .88	0.45
6. Chest Girth÷Stature	49.12 ± .18	48.69 ± .18	1.72
7. Hand breadth	80.10 ± .32	79.83 ± .35	0.57
8. Calf girth	339.70 ± 1.61	336.40 ± 1.57	1.47
9. Ear length	58.93 ± .26	58.87 ± .25	0.17

* All measurements given in mm. except weight (kg.) and the index of relative chest girth.

no Negro college women for comparison, but Herskovits, 1931, gives a mean of 159.8 cm. for 157 Mississippi Negro farm women of various ages. This mean equaled 5 feet 3 inches. The average weight of the Tuskegee women is likewise equal to the Smith College women. The figures are 55.8 and 55.6 kilograms or 123.0 and 122.6 pounds respectively. This figure also compares closely with the average weight of 120.69 pounds (54.74 kgs.) for 17,000 college women as given by Diehl, 1933.

Measurements on the chest, including girth, chest anterior-pos-

terior, and chest transverse are likewise similar for the two groups. Relative chest girth, or chest girth divided by stature, a rough indication of body build, is strikingly similar for these Negro and white girls. The calf, which is reputed to be racially different in Negroes than it is in whites, was found to have the same girth. It is true, the Negro calf girth is slightly larger than that of the white girls, but the difference is not significant. Hand breadths for the two groups, and also ear lengths, are statistically the same, but hand length and ear breadth are significantly different, thus making the hand and ear indices greatly different. Nine of the 53 dimensions considered in this study or 17 per cent are the same for these white and Negro girls. Thirty-two, or 60 per cent, of the dimensions show the Negroes to be larger than the whites. This is of interest since stature and weight of the two groups are the same. Chief among the dimensions in the category are those dealing with the appendages (see table 2). Thus, the Negroes have a larger span than whites. The dimension called span includes not only the arm length but also the shoulder width. Both dimensions are longer in Negroes than they are in whites. Thus the span is actually 69 mm. or nearly 3 inches longer in the Negroes than in the whites. This is interesting when one remembers that the statures of the two groups are the same. The relative span for whites is shown to be 99.41, which means that the span and the stature are very closely alike. The Negro relative span equals 104.58, a figure which means that the span is nearly 105 per cent of the stature. All the appendages of the Negroes are longer than those of whites. The Negroes have relatively shorter upper arms and relatively longer lower arms than whites as shown in the ratio $\frac{\text{lower arm length}}{\text{upper arm length}}$ (No. 20, Table II). This shows a mean of 79.9 per cent for Negroes and 76.3 per cent for whites. This long lower arm in relation to upper arm seems characteristic also of American Indians, since in the senior author's work on Navajo females ('40) a mean of 80.4 per cent was obtained and for Maya females ('32) a mean of 80 per cent was secured. From adult Dutch white females a mean of 75.2 per cent was obtained (Steggerda '32b).

Hand length and foot length are likewise longer in the Negroes. In both hand and foot indices, the ratio of the breadth by the length, the whites have a greater value than that of the Negroes. This indicates that the hands of whites are broader relatively than those of Negroes.

Head length and head girth are likewise greater in Negroes, whereas the head breadth and also the cephalic index, which is the ratio of width to length, is greater in the Whites. The Negroes may be called dolichocephalic as judged by their rather long heads, the index being 76 per cent for Negroes and 79 per cent for whites. Negroes are shown also to have a long face. Each segment of the face is longer than the

TABLE II

MEASUREMENTS FOR WHICH NEGROES ARE GREATER THAN WHITES*

Measurement	Negro	White	Difference / P.E. of Dif.
10. Chest transverse / Sit. superst. Ht.	46.46 ± .20	44.66 ± .19	6.43
11. Biacromial bdth.	370.10 ± 1.05	356.05 ± 1.02	9.62
12. Acromion height	1331.90 ± 4.44	1314.25 ± 3.46	3.13
13. Iliospinale ht.	944.30 ± 3.59	903.85 ± 2.93	8.74
14. Span	1709.10 ± 5.78	1640.25 ± 4.52	9.38
15. Span / Stature	104.58 ± .19	99.41 ± .10	24.62
16. Total arm length	551.40 ± 2.25	513.65 ± 1.77	13.20
17. Upper arm length	306.30 ± 1.37	291.55 ± 1.13	8.29
18. Lower arm length	244.65 ± 1.12	222.75 ± .90	15.21
19. Lower arm length / Total arm length	44.37 ± .10	43.27 ± .09	8.15
20. Lower arm length / Upper arm length	79.85 ± .30	76.32 ± .30	8.40
21. Upper arm girth	243.60 ± 1.62	240.35 ± 1.13	1.64
22. Lower arm girth	236.90 ± 1.04	229.35 ± .87	5.55
23. Hand length	192.05 ± .65	187.40 ± .67	5.00
24. Total leg length	793.50 ± 3.12	762.59 ± 2.57	7.65
25. Tibiale length	461.10 ± 1.75	421.85 ± 1.26	18.17
26. Foot length	249.50 ± .80	236.75 ± .74	11.70
27. Foot breadth	85.68 ± .38	83.17 ± .29	5.23
28. Head length	189.29 ± .46	186.43 ± .38	4.75
29. Head girth	564.00 ± 1.23	550.15 ± .88	9.17
30. Bizygomatic bdth.	132.58 ± .31	130.46 ± .28	5.05
31. Trichion to gnath.	177.66 ± .61	171.91 ± .51	7.19
32. Nasion to gnath.	125.62 ± .40	111.99 ± .38	24.78
33. Nasion to stomion	82.78 ± .33	71.43 ± .26	27.02
34. Nasion to subnas.	59.32 ± .27	50.51 ± .24	24.47
35. Nasion to gnath. / Bizygomatic bdth.	94.72 ± .29	86.95 ± .33	17.66
36. Nasal breadth	41.00 ± .18	32.28 ± .13	39.64
37. Nasal breadth / Nasion to subnas.	69.54 ± .37	63.71 ± .39	10.80
38. Bigonial bdth.	104.62 ± .29	100.37 ± .30	10.12
39. Mouth width	50.72 ± .22	49.51 ± .20	4.03
40. Ear breadth	36.17 ± .15	33.23 ± .17	12.78
41. Ear breadth / Ear length	61.64 ± .28	56.31 ± .29	13.33

* All measurements given in mm. except the various indices.

corresponding segments for the whites (see numbers 31 to 34 in table 2). Not only is the length of the face greater in the Negroes, but two width measurements, bizygomatic and bigonial breadth, are larger. Nose breadth, and the ratio of nose breadth to nose length is greater in Negroes than in whites. The ear breadth and the mouth width are greater in Negroes. The ratio of ear length to ear breadth is greater for Negroes than it is for whites, indicating a more circular ear for Negroes than is true for whites.

Table III presents the dimensions in which the whites are greater than the Negroes. As has been suggested, the whites have a far longer

trunk length, as measured by sitting height, than do the Negroes. They also have a larger pelvis than Negroes. Because of the narrow pelvis and broad shoulder, the Negro trunk gives an appearance of being more V-shaped. The ratio of the upper arm to the total arm (dimension 47, Table III), shows again that the Negroes have relatively shorter upper arms than the whites. Minimum frontal, on the other hand, which is the minimum measurement of the forehead (No. 52, table III), is very much greater in the whites than it is in the Negroes.

TABLE III

MEASUREMENTS FOR WHICH WHITES ARE GREATER THAN NEGROES*

Measurement	Negro	White	Difference / P.E. of Dif.
42. Sitting height	837.40 ± 2.11	868.40 ± 2.00	10.65
43. Intercristal bdth	276.20 ± 1.16	284.95 ± 1.06	5.57
44. Interspinal bdth.	239.90 ± 1.14	244.35 ± 1.29	2.59
45. Intercristal bdth. / Biacromial bdth.	74.76 ± .27	79.49 ± .28	12.13
46. Ht. of head and neck	292.40 ± .84	308.90 ± .84	13.87
47. Upper arm / Total arm	55.64 ± .10	56.74 ± .09	8.46
48. Hand breadth / Hand length	41.78 ± .15	42.47 ± .18	3.00
49. Foot breadth / Foot length	33.50 ± .13	34.81 ± .13	7.28
50. Head width	144.50 ± .30	145.98 ± .29	3.52
51. Head width / Head length	76.39 ± .20	78.50 ± .20	7.54
52. Frontal breadth	110.84 ± .30	117.50 ± .33	14.80
53. Frontal breadth / Head width	76.70 ± .18	80.49 ± .24	12.63

* All measurements given in mm. except the various indices.

There remains one outstanding difference between the two groups. It pertains to the incidence of tooth decay. Table IV shows the distributions and the mean number of tooth cavities for each group.

The mean number of teeth affected by tooth decay as evidenced by an active cavity or a filling or a pulled tooth was 4.06 for Negroes and 8.74 for whites. This is of interest and importance when one remembers

TABLE IV

MEAN, PROBABLE ERROR, AND STANDARD DEVIATION FOR THE NUMBER OF TOOTH CAVITIES IN NEGROES AND WHITES

No. of Cavities	Negro Frequency	White Frequency	No. of Cavities	Negro Frequency	White Frequency
0—1.99	29	4	14	1	4
2	20	9	16	1	3
4	24	6	18	1	4
6	14	16		—	—
8	7	23		100	100
10	2	23	Mean	4.06 ± 0.24	8.74 ± 0.28
12	1	8		3.56 ± 0.17	4.11 ± 0.20

that the mean age and also the range of distribution of ages was the same for the two groups.

SUMMARY

This study is of particular interest since it compares two racially different groups which are alike in vocation, age, height, weight, and chest measurements. In all the other body proportions considered there is some significant difference between the two races. In many of the proportions the Negroes are larger than the whites, in others the reverse is true.

The most obvious of these differences as found in this study are as follows:

1. All linear measurements of appendages are larger in the Negroes than in the whites.

2. The span in Negroes is nearly 105 per cent of the stature; in whites it is only 99.4 per cent.

3. Negroes have a longer lower arm in relation to the upper arm than do the whites.

4. Trunk length in whites is greater than in Negroes; on the other hand the Negro trunk is more V-shaped than the white trunk because of larger biacromial and smaller intercristal breadths.

5. Negroes have longer faces than whites, their heads are more dolichocephalic, their noses broader, and their ears more circular.

6. The incidence of caries among these Negroes is half that of the whites.

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Hypersensitiveness to Cold: A Condition Dangerous to Swimmers

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ONE day last summer at one of the beaches on the Atlantic Coast a young woman was observed floating on her back about 150 feet from shore. It was early in the season; consequently, the water was cold. Suddenly, without warning, she sank below the surface. Swimmers close by saw her go down and immediately brought her to shore, where she soon recovered. Her friends could not understand what had happened, for she was known to be an expert swimmer. One of us (Gabrielson) had the opportunity to scrutinize her closely and realized that she had collapsed because of the condition known as "hypersensitiveness to cold."

Approximately seven thousand persons lose their lives yearly in the United States by drowning, and many of them are expert swimmers. In many instances the cause of drowning is attributed to cardiac disease. There is no doubt that some of these deaths thus attributed to "heart disease" are actually the result of the syndrome known as "hypersensitiveness to cold."

The number of people possessing this hypersensitiveness is not known, and those responsible for giving instruction in swimming should be familiar with the signs and symptoms of this condition. It is hoped that this article may help to spread this information.

HISTORICAL BACKGROUND

In 1927 there was reported in the medical literature by Horton [1]* the first case involving this syndrome. The report concerned a strong young man, twenty-two years old, who had collapsed on the shore of Lake Superior near Duluth, Minnesota, after being in swimming. Later we were able to reproduce this syndrome of hypersensitiveness to cold by exposing this young man to cold water for only a short period.

In 1935, Horton, Brown, and Roth [2] presented in the *Journal of the American Medical Association* a review of all the literature on the subject. Up to 1936 twenty-four cases of syncope following swimming had been reported. Nine of the twenty-four subjects had had to be

* Refer to numbered Bibliography at end of article.

rescued from the water, and if help had not been available there might have resulted more of the so-called heart failure caused by swimming in cold water. In many of these cases the persons were good, if not expert, swimmers. Since the aforementioned report was published, one of us (Horton) has received a number of letters from physicians in different parts of this country telling of subjects who have collapsed while swimming; some of these had to be rescued from the water. Two physicians stated that they each had sons who had undergone this experience.

RECOGNITION OF THE SIGNS

Hypersensitiveness to cold is undoubtedly much more common than is indicated by the relatively few cases reported in the medical literature. The signs and symptoms may be classified as (1) local and (2) systemic. The local reactions are easily recognized: the skin exhibits a pallor during the period of exposure to cold and this is followed by redness, *swelling*, and increased temperature of the skin on removal of the exposed part from the cold. The skin also may exhibit urticaria or hives after exposure. After a latent period of from three to four minutes following the exposure, the systemic effects are manifested: there is a characteristic reaction which consists of a sharp decrease in blood pressure, an increase in pulse rate, a flushing of the face and a tendency toward or the actual development of, syncope.

The factors that seem to influence the local and systemic reactions are the length of the exposure and the temperature of the water. If the water is cold the exposure need not be so long as would be necessary in warmer water.

NATURE OF THE LOCAL AND SYSTEMIC REACTIONS

Experimental work which has been carried out at The Mayo Clinic has given evidence of the chemical nature of these reactions and strongly suggests the release of histamine or a histamine-like substance in the skin following exposure to cold. This chemical substance not only produced the local phenomena, but when absorbed into the general circulation, it also produced a reaction characteristic of that produced by histamine.

STANDARD TESTS FOR DETERMINATION OF HYPERSENSITIVENESS TO COLD

Two standard tests have been used to determine this hypersensitiveness. The first is preferable in view of the fact that it gives a better systemic reaction.

The steps for performance of the first test are: (1) place the subject in a supine position; (2) take blood pressure and pulse readings every two minutes for from five to ten minutes; (3) immerse the hand and forearm of the subject in water of 8 to 10°C. (46.4 to 50°F) for

from five to ten minutes; the water line should be well above the wrist; (4) record blood pressure and pulse readings at the end of five minutes while the subject's hand is still in the water; (5) remove the subject's hand from the water; (6) continue taking blood pressure and pulse readings every two minutes for the next fifteen to twenty minutes; (7) watch for swelling of the hand; have the subject clench his fist and have him note any tight feeling and (8) watch for the signs of urticaria or hives on the exposed hand, although these signs may not always occur.

Figure I illustrates the changes in blood pressure and pulse rate that occur in the hypersensitive person. The definite decrease in both the systolic and diastolic blood pressure as a result of the exposure should

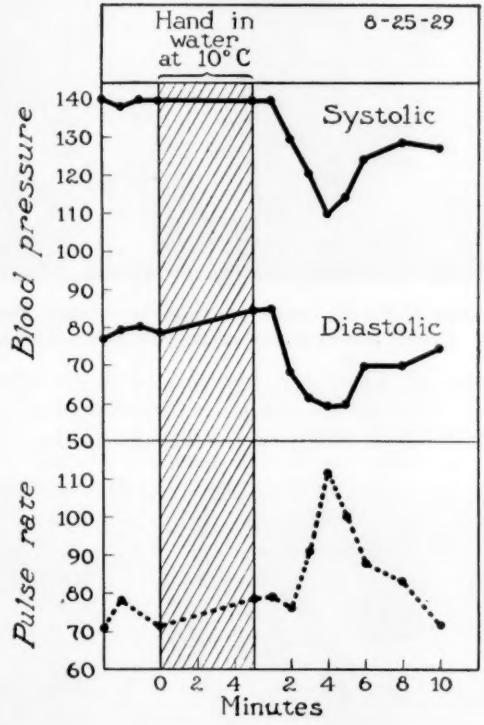

FIG. I. Systemic reactions to test 1 for hypersensitiveness to cold. Note the decrease in blood pressure and the increase in pulse rate following exposure.

be noted. The systolic blood pressure began to decrease one minute after the exposure, and at the end of four minutes had decreased from 140 to 108 mm. of mercury, while the diastolic dropped from 82 to 58 mm. Figure II illustrates the swelling of the left hand as a result of the

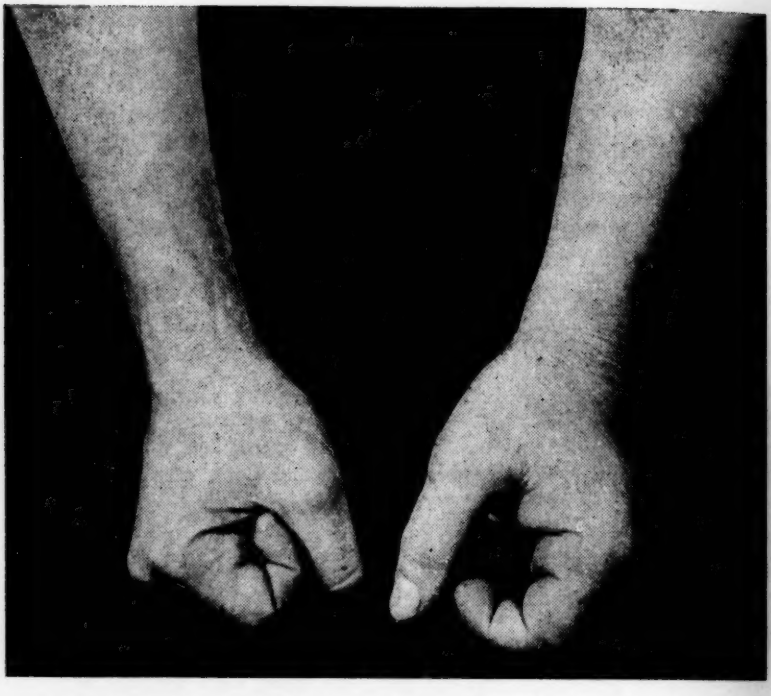

FIG. II. Swelling of the left hand after exposure to water at 10° C. (50° F.) for eight minutes. Patient is unable to make a fist with the left hand.

exposure. Figure III illustrates this reaction in an extremely hypersensitive person. The definite line of demarcation, which indicates the depth to which the hand was immersed in water, should be noted.

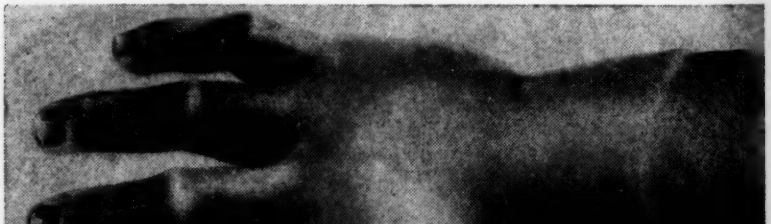

FIG. III. Local reaction to test 1 in an extreme instance of hypersensitiveness to cold. The hand had been exposed to water at 10° C. (50° F.) for five minutes.

The steps in the performance of the second test are: (1) place the subject in a sitting position; (2) take an ice cube or its equivalent and place it on the forearm for three minutes, holding it in place with a piece of paper or a towel; (3) remove the ice, and watch for the formation of a wheal; this usually will occur within two to five minutes after the exposure if the person is hypersensitive. The wheal is slightly raised and is surrounded by a red flare (Fig. IV).

FIG. IV. Local reaction which has occurred after application of ice cube to the forearms. Note the development of wheal and flare.

PRACTICAL INSTANCE OF HYPERSENSITIVENESS TO COLD

Last summer (1939) a male patient, about thirty-five years of age, who lived in a town in Northern Minnesota, appeared at The Mayo Clinic. He complained that during the fall and winter months he did not dare go outside the house because his face and hands would swell. This was inconvenient, to say the least. He had a job in a factory about a block from his home, and each morning and evening, as he went to or left this factory he was forced to wrap shawls around his face to keep the cold from affecting him. Often this necessitated someone's leading him to and from the factory, because he had so many shawls wrapped around his face that he could not see. When swelling of the face occurred it usually remained for twenty-four hours. He had been aware of this condition for about twenty years, and during this time he had refrained from swimming, although as a youngster he swam regularly.

He was given test I for hypersensitiveness to cold and the reaction was positive. The following day he was told to swim in a pool. After considerable shivering and flushing of the face, he collapsed, and had to be rescued. If this collapse had occurred in one of the lakes in the north he would have drowned.

CAUSATION OF HYPERSENSITIVENESS TO COLD

The local and systemic reactions of the hypersensitive person correspond to those produced by an injection of histamine or of a histamine-like substance.[3] Physical agents such as cold seem to permit a release of chemical substances from the tissue cells resulting from increased permeability. As a result of exposure to cold it appears that the histamine thus released finds its way to the blood, and that this substance in addition to producing the usual local changes, attains sufficient concentration in the hypersensitive individual to produce reactions very similar to those obtained by injecting it into the body. In 1931, McHenry and Best [4] demonstrated that histamine was destroyed in the body by an enzyme they called "histaminase." After much experimental work they reported that histaminase was found in fairly large amounts in the walls of the large and small intestine and in the kidneys, in moderate amounts in muscles, spleen, lungs, adrenal glands, and bladder, and in small amounts in the heart and skin. In 1937 Roth and Horton [5] reported the successful treatment with histaminase of a patient who had hypersensitiveness to cold.

TREATMENT

People who exhibit hypersensitiveness to cold are amenable to treatment. Four methods are used in treating these patients: (1) "desensitization" by the immersion of the patient's hand in water of 10°C (50°F.) temperature for one to two minutes, twice a day for three or four weeks (Fig. V), (2) "desensitization" of patients by a subcutaneous injection of 0.05 to 0.1 mg. or less of histamine administered twice daily for two or three weeks, (3) administration of histaminase * for a period of several weeks, (4) intravenous injection of histamine, 1.0 mg. dissolved in 250 c.c. of physiologic solution of sodium chloride. This solution must be administered very slowly.

PREVENTION

The important preventive measure is that people who are swimming should be aware of this condition and should begin to watch for its occurrence, at public beaches. When people faint on the beach after having been in the water, they should be examined for the signs and symptoms of hypersensitiveness to cold. Many times urticaria will appear in the region of the neck, arms, or legs. It must be remembered that this condition is not only the result of exposure to cold water, but also to cold atmospheric temperatures such as are found in the winter season. Some people are confronted with this condition as a result of proceeding from a hot atmospheric condition to an air-conditioned theater or other building in which there may be a draft.

It is possible that people are more susceptible to this condition in the summer than in the winter; this may be because of the occurrence

* This substance is sold under the trade name of "torantil."

of natural "desensitization" of the subject in the winter resulting from contact with gradual decreases in atmospheric temperatures.

The authors would appreciate hearing reports of any occurrences of this condition.

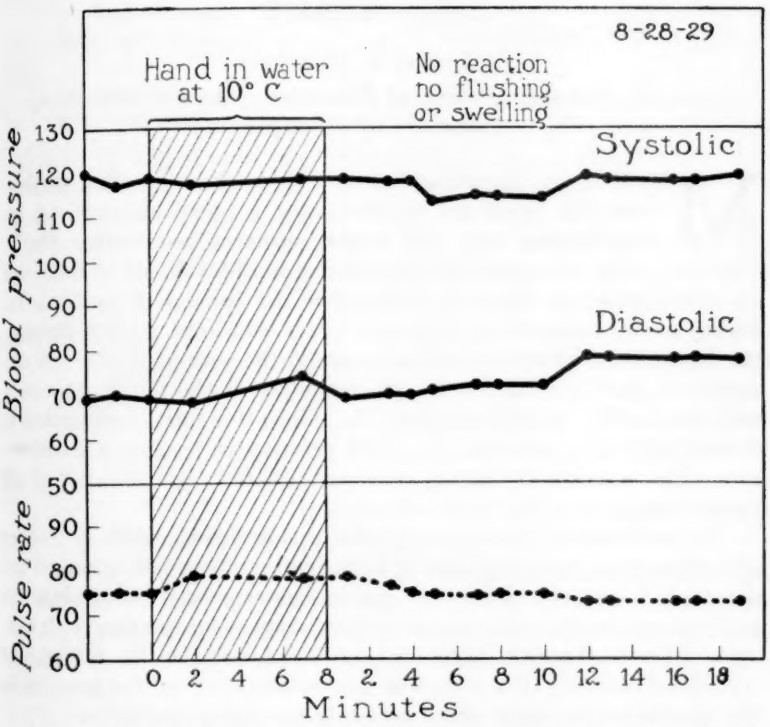

FIG. V. Data pertaining to the same subject as is concerned in Figure I. This patient had immersed the hands in water at 10° C. (50° F.) twice daily for only three days, and was practically well at the end of that time. Note the absence of significant changes in blood pressure and pulse rate.

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The Prospective Teacher and His Knowledge of Contemporary Life Affairs

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MUCH of the literature dealing with teacher education emphasizes the "need for teachers with a broad outlook and an acquaintance with the larger issues of present-day life."[1] That schoolmen are agreed that prospective teachers should be informed on contemporary problems is evidenced in the findings of the National Survey on the Education of Teachers.[2] It is evidenced, further, through the introduction of courses and seminars in the various institutions designed to give the students an understanding of the significant issues and relationships in contemporary life. Since this type of education is deemed desirable, the extent to which prospective teachers are conversant with contemporary affairs deserves the serious consideration of all those engaged in professional education.

An awareness of contemporary affairs as one of the goals of teacher education opens up a wide field of investigation. How well informed are prospective teachers with the major contemporary happenings in political, social, and economic life? How conversant are they with current affairs in the area chosen for specialization? Do the teachers of traditional subjects rank higher in this respect than do the teachers in the special-subject fields where curricula are highly specialized?

While the scope of this study is too limited to give final answers to any of these questions, many interesting facts are revealed, and problems which demand further investigation are indicated. It is believed that these findings will be of interest to those concerned with teacher education.

STATEMENT OF PURPOSE

The purpose of this investigation was to study the contemporary life comprehension of prospective teachers.

THE PROCEDURE

Test Selection.—The American Council on Education Contemporary Affairs Test for College Students (Form 1939) was used in this

[1] C. H. Judd, *Next Steps in Teacher Education* (American Association of Teachers' Colleges, 1924) 27.

[2] *National Survey on the Education of Teachers* (Washington, D.C.: United States Department of Interior) Teachers Education Curricula, Vol. III.

study. The sections of the test with the number of questions included in each section (and subsection) are listed as follows:

	PART I	
Politics		60
National	30	
International	30	
Social and Economic		60
Social	30	
Economic	30	
Science and Medicine		30
Science	17	
Medicine	13	
	PART II	
Contemporary Literature		45
Literature	45	
Fine Arts		45
Art	15	
Music	15	
Drama	15	
Amusements		60
Movies	25	
Radio	15	
Sports	20	
	Total	300

Test Administration.—

a) Subjects: This test was given during the year 1939–40 to 323 University of Michigan students (93 men, 230 women) who were enrolled in education courses required for a teachers certificate in Michigan. The classification of the 323 subjects taking this test was as indicated:

Sophomores	24
Juniors	189
Seniors	87
Graduates	20
Specials	3

b) Uniformity of Procedure: Since the taking of this test was optional for the students, it was necessary to administer it at nine different periods from November 1939 to March 1940. All the standardized directions for the administration of the test were rigidly followed, except for the time factor. Students were permitted to turn in the test when work was completed. The maximum time allowed for the test was 100-minutes. The average time for completing the test was 82 minutes. Sixty-five minutes was the least time spent by any student.

Test Scoring.—Each of the 300 questions on the test scored one point, making a possible total score of 300. Scores were computed for

each section of the test, and for Part I and Part II separately and combined, in accordance with the standardized directions.

THE RESULTS OF THE TESTING

Interpretation of scores on such a test must be on a comparative basis. The National scores published for this test are based on the performance of 5701 sophomore students in the various colleges throughout the country. It should be emphasized in any comparison of scores that the Michigan group was comprised of sophomore, junior, senior, and graduate students. Undoubtedly, the fact that upperclass students were included in the Michigan group tends to raise the average performance, in that the mean scores of the group on the total test increase progressively with college classification (see Table I).

TABLE I

COMPARISON OF MEAN SCORES OF MICHIGAN GROUP AS CLASSIFIED IN COLLEGE

Class	Sophomores	Juniors	Seniors	Graduates	Total
No. of Cases	24	189	87	20	320
Scores	72.42	89.08	101.84	116.35	

Table II shows the *range* of scores made by the National and Michigan groups for each section of the test and for the total test. Actually, there was slight difference between the two groups in this comparison. On the total test score, the highest individual in the Michigan group was twelve points above the highest score recorded for the National

TABLE II

COMPARISON OF THE RANGE OF MICHIGAN SCORES WITH THE RANGE OF NATIONAL SCORES

	High Scores		Low Scores	
	Michigan	National	Michigan	National
Politics	53	58	3	1
Soc. and Econ.	51	55	0	0
Sc. and Med.	15	24	0	0
Total Part I	116	120	9	4
Literature	38	41	0	0
Fine Arts	36	33	0	0
Amusements	58	58	0	2
Total Part II	123	116	6	6
Total Test	239	227	25	14

group. It is significant to note, however, that this high score was made by a graduate student. At the low end of the scale, the performance for both groups was extremely poor.

A comparison of the mean scores on each section of the test and

on the total test favors consistently the Michigan group, while the sigma for both groups remains fairly constant (see Table III). If, however, one compares the sophomore mean of the Michigan group on the total test (see Table I) with the mean of the National group (comprised wholly of sophomores) it will be noted that the Michigan sophomores are ten points below the National mean. The fact that the Michigan sophomore group is very small (24) may account somewhat for this discrepancy.

TABLE III

COMPARISON OF MEAN SCORES OF MICHIGAN AND NATIONAL GROUPS

Sections of Test	National Mean	Michigan Mean	National Sigma	Michigan Sigma
Politics	19.7	21.9	10.9	10.2
Soc. and Econ.	15.2	18.9	8.8	9.5
Sc. and Med.	4.3	5.7	3.4	3.8
Total Part I	39.2	47.2	20.8	20.0
Literature	8.0	11.0	5.7	5.9
Fine Arts	8.8	11.8	5.7	6.1
Amusements	26.4	27.2	10.6	10.0
Total Part II	43.2	51.0	18.8	18.4
Total Test	82.4	98.0	36.1	33.9

The mean scores made by the Michigan men were higher consistently than those made by the Michigan women (see Table IV), except in current literature, where the women's score is slightly above that of the men. The mean scores for the Michigan men are well above the National means in all sections of the test (see Table III). They are above the Michigan means also in all sections of the test

TABLE IV

COMPARISON OF MEAN SCORES OF MICHIGAN MEN AND WOMEN

Sections	Men	Women
Politics	28.6	21.3
Soc. and Econ.	25.9	16.4
Sc. and Med.	6.8	5.2
Total Part I	62.2	41.1
Literature	10.9	11.4
Fine Arts	13.0	11.4
Amusements	33.3	24.8
Total Part II	57.6	47.9
Total Test	118.9	90.7

except in current literature, where they fall but one-tenth of a point below the highest group performance. This would lead one to believe that, in general, men know more about events occurring in contemporary life than do women. Little attempt has been made to determine

the factors influencing these findings, but such information might prove of value in guidance work.

Percentile scores on the American Council on Education Psychological test were available for 167 of the 323 Michigan students participating in this study. Correlating this score with the percentile scores on the Contemporary Affairs test yielded a result of +.42, with a P. E. ± .04. It appears that intelligence as judged by the American Council test is not a determining factor for successful performance in the Contemporary Affairs test.

To answer the question, "How well informed are prospective teachers on current affairs in the area chosen for specialization?" the 323 students taking the test were grouped according to their major-subject fields (i.e., history, English, etc.). Five groups resulted from this classification with numbers deemed large enough to indicate a trend. Fortunately, the five groups emerging from this sorting represented in interest the content of the various sections of the test. These groups were:

1. History and Social Science (to be called the *Social Science* group in further discussion).
2. English.
3. Physical Education.
4. Music and Art (to be called the *Art* group in further discussion).
5. Public Health and Public Health Nurses (to be called the ***Public Health*** group in further discussion).

One might question the inclusion of the Public Health group in the comparative treatment of data which follows, in that many of the individuals making up this group will not necessarily be engaged in teaching. Moreover, many of the public health nurses are older than the average undergraduate student. The former have had limited experience in the traditional college subjects, but they can be credited with wide experience in practical field work in health. These factors should be recognized in any comparison of subject-matter groups. The only justification for the inclusion of this group is that the test included a section devoted entirely to science and medicine which most closely parallels their field of interest. One might expect this group, and possibly the Physical Education group, to score high in this area since their class work includes many courses in science.

Enlarging on this idea, one would assume that the Social Science group would rank high in politics and in the social and economic section of the test, while the English group might make a better score in current literature. These suppositions were found to be true in certain sections of the test, as shown in Table V. The Social Science group made the best score on politics as well as on the section concerned with social and economic problems. In current literature the English group had the highest score according to expectancy. This group led also in

the amusement section. In the Fine Arts area, the Art group scored but one-tenth of a point below the highest group (Public Health). This appears somewhat significant in that in other sections of the test the Art group's average score placed them low in group ranking. The difference in score on this particular section of the test for all groups was very slight. In science and medicine this theory does not hold, since the English and Social Science groups were highest in this area. The mean scores in this section of the test are so low however, and so consistent for all groups, that they appear insignificant.

TABLE V

COMPARISON OF MEAN SCORES OF THE MICHIGAN SUBJECT MATTER GROUPS

Groups	Social Science	English	Physical Education	Art	Public Health
No. of Cases	72	37	41	30	30
Politics	26.5	22.7	17.7	18.0	17.1
Soc. and Econ.	23.9	20.1	16.2	14.2	12.4
Sc. and Med.	5.6	5.6	5.1	4.2	5.5
Total Part I	56.1	48.4	39.0	36.4	35.0
Literature	11.9	14.1	8.7	8.5	8.6
Fine Arts	12.5	13.3	10.0	13.6	13.7
Amusements	29.8	31.7	27.1	24.7	17.4
Total Part II	54.2	59.1	45.8	46.8	37.7
Total Test	110.3	107.5	84.8	83.2	74.7

Figure I shows graphically the achievement of each of the subject matter groups in Part I of the test (politics, social and economic events, and science and medicine) as compared with the National and Michigan means.

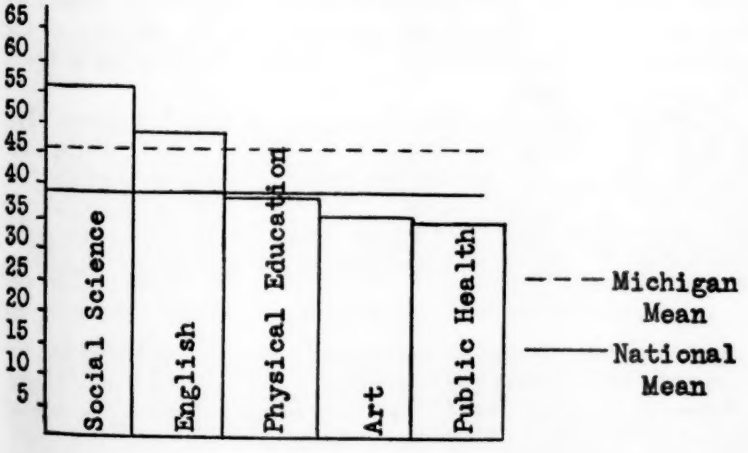

FIGURE I

Two of these groups (Social Science and English) were above both means while the Physical Education group is but two-tenths of a point below the National mean. In other words, the performance of the latter group is on a par with college sophomores. None of the special subject matter groups (Physical Education, Art, and Public Health) approximated the average performance of the Michigan group.

Figure II shows the relative achievement of each group in Part II of the test (literature, fine arts, and amusements) as compared to the

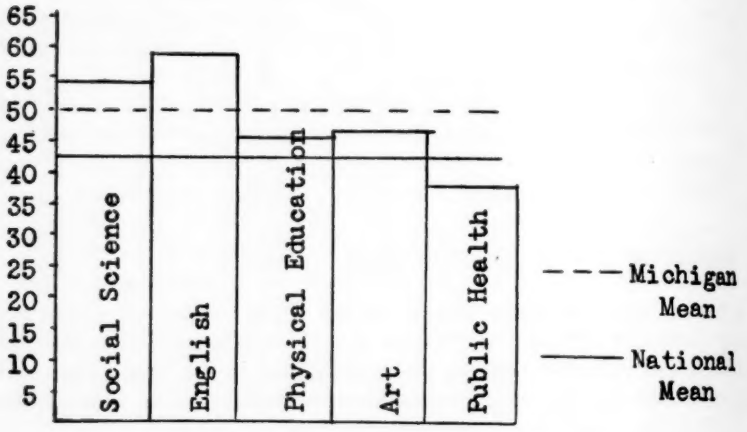

FIGURE II

performance of the National and the Michigan groups. Here again the Social Science and the English groups are above both the National and the Michigan means. The Physical Education and the Art groups are above the National mean on this section of the test, but they do not approximate the Michigan mean. The Public Health group is below both means as in Part I.

Figure III makes the same comparison on total test scores. The result of this analysis is comparable to that of Part II of the test. The Social Science and the English groups were higher than the National and the Michigan means. The Physical Education and Art groups were higher than the National mean, but they were below the Michigan mean. The Public Health group was below both means.

SUMMARY

The American Council on Education Contemporary Affairs test for College Students (Form 1939) was given to 323 University of Michigan students (93 men, 230 women) who were enrolled in education courses required for a teaching certificate in the state of Michigan. Since this group was composed of sophomores, juniors, seniors, and graduate stu-

dents, the mean scores on the total test were computed for each group as classified in college. The range made by the Michigan group was then compared with the range of scores made by the National group on each section of the test and on the total test. The mean scores of the total Michigan group were next compared with the National means

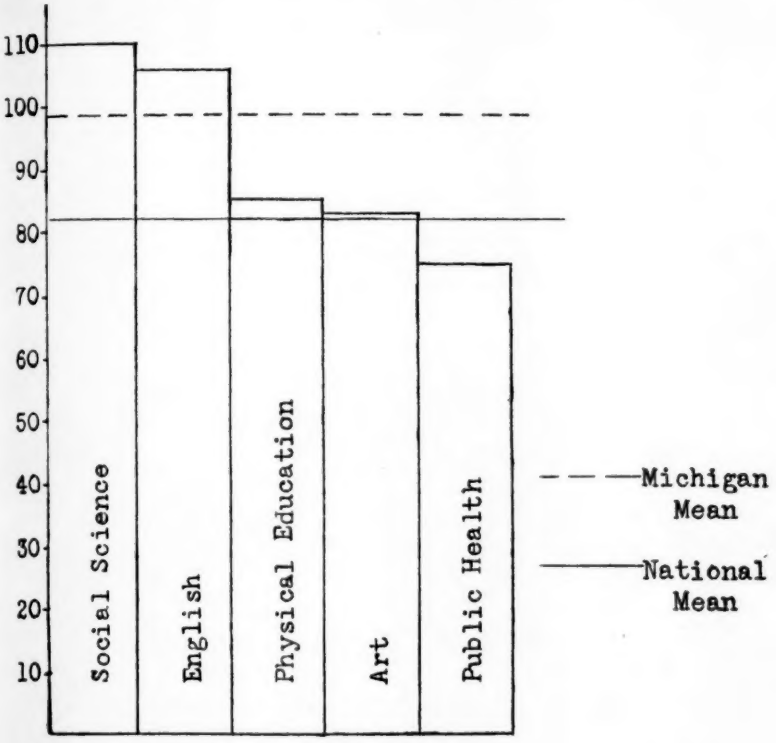

FIGURE III

for each section of the test, and on total test. The mean scores for Michigan men and women were computed separately for each section of the test, and a comparative analysis was made of the achievement of each group. Since percentile scores for the American Council on Education Psychological test were available for approximately 50 per cent of the Michigan students participating in this study, these scores were correlated with the percentile scores on the Contemporary Affairs test for the same students.

The Michigan group was then classified according to teaching majors. Five groups, with numbers deemed large enough to denote a trend, resulted from this sorting. These groups were Social Science, English, Physical Education, Art, and Public Health. The mean scores

for each section of the test, and for the total test were computed for each of these five groups. The relative achievement of each group on each section of the test was analyzed as well as scores on the total test. The total scores for each group were compared further with the National and the Michigan means.

The results of this study may be summarized as follows:

1. There was a consistent increase in group scores on the Contemporary Affairs test with increased experience in college work (as judged by college classification).

2. There was little difference in the *range* of scores between the National and Michigan groups on the five sections of the test. The highest Michigan score on the total test exceeded the highest National score by twelve points. This high Michigan score was made by a graduate student, however.

3. The mean scores for the Michigan group exceeded the mean scores of the National group on all sections of the test, and on total test score.

4. The mean scores for the Michigan men exceeded the mean scores for the Michigan women on all sections of the test, except for current literature, where the woman scored slightly higher. The men also scored higher on the total test.

5. The mean scores of the Michigan men exceeded the National means on all sections of the test. They exceeded the Michigan means on all sections of the test, also, except in contemporary literature.

6. A coefficient of $+ .42$ P.E. $\pm .04$ was the result of correlating the percentile scores on the Contemporary Affairs test with the percentile scores on the American Council on Education Psychological test.

7. The Social Science and English groups were the only subject matter groups which approximated or exceeded the National and the Michigan means on Part I of the Contemporary Affairs test. This section dealt with politics, social and economic events, and science and medicine. The Physical Education group was but two-tenths of a point below the National mean in this section of the test.

8. All the subject matter groups, with the exception of Public Health, exceeded the National mean on Part II of the test, but only the Social Science and English groups exceeded the Michigan mean on this part of the test.

9. The results of the total test were comparable to the results on Part II of the test (see 8).

10. The Social Science group ranked first on the political and social and economic sections of the test.

11. The English group ranked first on the literature section of the test.

12. The Art group ranked one-tenth of a point below the highest group (Public Health) on the fine art section of the test.

13. The English group ranked first on the amusement section.

14. The scores on the science and medicine section of the test were so consistent as to show little variation between the groups.

CONCLUSIONS

In drawing any conclusions relative to this study, attention should be directed again to the small number of cases on which such conclusions must be based. The nature of the test was such that it was impossible to continue its administration to secure the numbers necessary to substantiate the evidence presented herein. World events have moved so rapidly in the past year that any contemporary affairs test has limited usefulness because it is outdated so rapidly. With full recognition of this limitation, the following conclusions are presented:

1. There is a wide variation among college students relative to their knowledge of events occurring in contemporary life. This variation is demonstrated by the National group composed of college sophomores and by the group of prospective teachers at the University of Michigan.

2. The average college student is not well informed concerning contemporary life affairs, since the mean scores for the test are low for all groups.

3. Increased experience in college work tends to increase the score on the Contemporary Affairs test.

4. The men in the Michigan group are better informed on contemporary affairs than are the women.

5. Intelligence, as judged by the American Council on Education Psychological test, seems to be a non-determining factor insofar as a knowledge of contemporary affairs are concerned.

6. The students preparing for the so-called "special subjects" (Art, Physical Education, Public Health) at the University of Michigan appear to be less well informed concerning contemporary affairs than are the prospective teachers in the more traditional academic subjects. The fact that these "special subject" groups fell below both the National and the Michigan means in Part 1 of the test deserves consideration, in that this part of the test covered the areas of knowledge that leading educators have emphasized as being extremely important for all teachers.

7. The Physical Education group ranks higher in this study than do the other two special subject matter groups studied. They did not however approximate the Michigan means in any section of the test.

8. There appears to be a tendency for prospective teachers to be somewhat better informed concerning contemporary affairs in their field of specialization than in other areas of knowledge.

Tests of Change of Direction as Measurements of Different Kinds of Motor Ability in Boys of the Seventh, Eighth, and Ninth Grades

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CONSIDERABLE research has been done in the field of the measurement of motor ability and, according to published reports, it has been well analyzed from various angles. There is one important element of motor ability, however, that has not been thoroughly investigated, namely, the change of direction factor. Numerous writers agree that change of direction is an important element of motor ability and that change of direction is an important factor in determining success in games, such as football, basketball, and tennis. Kathryn E. Young made a start toward determining the relative importance of change of direction skills in motor ability, but concluded that further research was advisable.[8]*

STATEMENT OF THE PROBLEM

The first purpose of this study is to determine whether change of direction skill is an important factor in agility and games ability.

The second purpose is to select a battery of change of direction tests that are convenient to administer, and which adequately measure the different types of this particular skill.

REVIEW OF THE LITERATURE

Investigation reveals that studies in the field of physical education pertaining to this problem which have been reported in the literature are relatively few. Of the fifteen change of direction tests included in the initial battery, seven have been used in measuring some form of motor ability, but only five for measuring change of direction ability.

In 1928, Cozens,[2] at the University of Oregon, reported the results he obtained in measuring the general athletic ability of college men. Of the forty-one elements of general athletic ability included in the

* Refer to numbered Bibliography at end of article.

study, the dodging run was used as a test of change of direction. Cozens says, "This event is to measure not only speed of legs but ability to change direction quickly, a quality that is extremely important in all types of athletic endeavor, basketball, hockey, speedball, tennis, and the like." He obtained a correlation of .729 in his comparison of the dodging run with the criterion.

In an analytic study of tests of change of direction made by Young [8] in 1937, the Howe test, the zig-zag run, and the figure-eight test were used as change of direction elements. In the conclusions drawn by Young, general strength and leg strength do not have any large effect on the change of direction factor. Velocity and dead-weight however, do affect the factor of change of direction. The factor identified as agility, or change of direction, had a correlation of .4103 with the Burpee test; .3510 with the zig-zag run; .4246 with the Howe test; and .1543 for the figure-eight test.

In 1934, L. W. Johnson [5] made a study of objective basketball tests for boys, in which he used a form of the zig-zag run and two other tests involving elements of change of direction. Johnson's zig-zag run, however, was not used as a measure of change of direction ability, but to test speed in basketball dribbling. His 6- and 20-foot side-step tests were used as tests of the shifting element of basketball.

In 1932, Alden, Horton, and Caldwell [1] used the 40-yard maze run as an element in a motor ability test for women. The correlation of modern sports and stunts with the 40-yard maze run was .56.

COLLECTION OF THE DATA

Subjects Used.—The tests used in this study were administered to 160 seventh-, eighth-, and ninth-grade boys. The testing was carried on in connection with the regular testing program in physical education to insure earnest effort on the part of the subjects. Eighteen tests were included in the original battery, fifteen of which were selected for measurement of the change of direction factor, and three of which are commonly used tests of motor ability. The latter were the Johnson, the Iowa Brace, and the Burpee tests.

Administering the Tests.—The first step necessary for obtaining systematic records was to make a scoring sheet. The scoring sheet had spaces for recording the scores on the first and second trials, spaces for age, height, and weight, and spaces to record a judgment of agility and games ability.

Before any of the tests were run, the age, height, and weight were tabulated in the proper spaces. A judgment was made of the agility and of the games ability of each subject and recorded. The judgments of games ability and agility were made on the basis of the three categories—good, fair, and poor.

In administering the tests, the subjects were given a practice trial to acquaint them with the course. Each test was administered twice, several days apart, as a check on reliability. A damp towel was placed at the starting line, for each of the change of direction tests, to insure good traction. The starting method was the usual "get set, go" type. The watch was started on the word "go" and stopped as the subject crossed the finish line. If the subject slipped, became confused, or in the tester's opinion was not doing his best, he was stopped, and after a short rest started over again.

The Johnson, the Burpee, and the Iowa Brace tests were administered as recommended by McCloy.[6]

ANALYSIS OF THE DATA

Computation of Reliabilities.—The reliability of each test was obtained by computing the coefficient of correlation of the first trial against the second by means of the Pearson product-moment formula. The reliabilities were found to be very high for the change of direction tests, ranging from .904 to .981. A summary of these reliabilities is presented in Table I.

Computation of T-Scores.—In order to obtain a total of all the change of direction tests to be used as a criterion of this ability it was necessary to convert the raw scores into standard scores. This was done by the method known as the McCall T-Score technique.

Relationship of Change of Direction Skill to Games Ability and Agility.—Triserial correlations were used in determining the relationship of change of direction skills to games ability and agility. The triserial correlation is merely an extension of the familiar biserial technique used in psychology and education (see McCloy [7]).

In computing triserial correlations of total T-score against agility and games ability, the following results were obtained: total T-score vs. agility, .8618; total T-score vs. games ability, .8034.

From these figures it is apparent that tests of the ability to change direction quickly measure an important factor in agility and games ability.

Selection of the Final Battery.—The Pearson product-moment formula was used in computing the coefficient of correlation between each test and the total T-score. (see Table I).

From these results the batteries of tests were selected. The tests in each battery were selected with the following points in mind: size of correlation with the criterion, ease of administration, and how well they represented the different types of change of direction skills.

The batteries for the seventh, eighth, and ninth grades, together with the regression coefficients and the multiple correlation of each battery with the criterion, are as follows:

TABLE I

ZERO-ORDER CORRELATIONS AND RELIABILITY COEFFICIENTS

Tests			Grades			Reliability
			7	8	9	
Loop-the-loop	vs.	Total score	.781	.810	.732	.970
Boomerang, right	vs.	Total score	.866	.785	.819	.925
Boomerang, left	vs.	Total score	.702	.768	.760	.955
Dodge run	vs.	Total score	.876	.756	.694	.968
40-Yard maze run	vs.	Total score	.924	.744	.800	.954
Gauntlet dodge run	vs.	Total score	.838	.787	.802	.917
Zig-zag side step	vs.	Total score	.889	.800	.759	.918
Zig-zag run	vs.	Total score	.871	.748	.841	.934
8-Foot shuttle run	vs.	Total score	.731	.756	.753	.904
15-Foot shuttle run	vs.	Total score	.853	.756	.801	.928
30-Foot shuttle run	vs.	Total score	.865	.810	.813	.932
Howe test	vs.	Total score	.733	.624	.701	.981
Auto tire test	vs.	Total score	.752	.796	.526	.974
Figure 8	vs.	Total score	.825	.796	.679	.954
Cross hop	vs.	Total score	.374	.501	.721	.937
Burpee test	vs.	Total score	.632	.479	.538	.921
Iowa Brace	vs.	Total score	.664	.461	.736	
Johnson test	vs.	Total score	.659	.439	.464	
40-Yard maze run	vs.	Zig-zag side step	.805	—	—	
40-Yard maze run	vs.	30-Foot shuttle run	.822	—	—	
Zig-zag side step	vs.	30-Foot shuttle run	.818	.557	—	
Loop-the-loop	vs.	Zig-zag side step	—	.693	—	
Loop-the-loop	vs.	30-Foot shuttle run	—	.616	—	
Boomerang, right	vs.	Zig-zag run	—	—	.719	
Boomerang, right	vs.	30-Foot shuttle run	—	—	.683	
Zig-zag run	vs.	30-Foot shuttle run	—	—	.731	

Seventh Grade:

.771 x 40-Yard Maze Run (T-score)
+ .409 x Zig-Zag Side Step (T-score)
+ .205 x 30-Foot Shuttle Run (T-score) R = .959

Eighth Grade:

.389 x Loop-the-Loop (T-score)
+ .449 x 30-Foot Shuttle Run (T-score)
+ .528 x Zig-Zag Side Step (T-score) R = .946

Ninth Grade:

.397 x Zig-Zag Run (T-score)
+ .460 x Boomerang, Right (T-score)
+ .453 x 30-Foot Shuttle Run (T-score) R = .918

DISCUSSION

Several of the tests were used somewhat differently than the authors of the various tests prescribed. The dodge run, the zig-zag run, the zig-zag side step, the shuttle runs, and the cross hop were all run against time. Changes were made in these tests to simplify the scoring, and to place all the scoring on a time basis.

The scoring tables (see Appendix) are used as follows: to find the

weighted score that corresponds to the raw score, follow down the left column until the whole number is found, then follow along this row until the proper "tenth" column is reached; then the score at the space where the column and row meet is the desired weighted score. The sum of the weighted scores for each battery constitutes the total score and gives a fairly reliable measure of change of direction ability. These tables have been set up so that the resultant total score is equivalent to a T-score in which 50 is average ability and deviations above and below are indications of above and below average performance respectively.

A study of the correlations of test scores against total scores reveals the fact that the 30-foot shuttle run in the seventh grade is not among the three highest tests in correlation. The boomerang to the right, dodge run, and zig-zag run have slightly higher correlations than the 30-foot shuttle run. The reason for selecting the 30-foot shuttle run in the seventh grade is that the dodge run is similar in action to the 40-yard maze run, which has the highest correlation. Similarly the battery would be unbalanced if both the zig-zag side step and the zig-zag run were included. The correlations of the boomerang to the right and the 30-foot shuttle run were almost identical so either of them could be employed. It was the author's purpose to select batteries of tests containing different patterns in testing the change of direction factor.

CONCLUSION

1. Evidence presented in this study tends to indicate that change of direction skill is an important factor in determining agility and games ability.

2. The tests suggested in the final battery are valid for measuring agility and games ability.

3. The tests suggested are particularly desirable as a measure of agility and games ability because (*a*) they are easy to administer, and (*b*) the equipment needed for them is readily available in any gymnasium.

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APPENDIX

1. *Loop-the-Loop.*—Indian clubs are placed 9 feet apart as shown in Figure I. The course taken is indicated by the lines and arrows. The pupil's score is the time taken for the round trip.

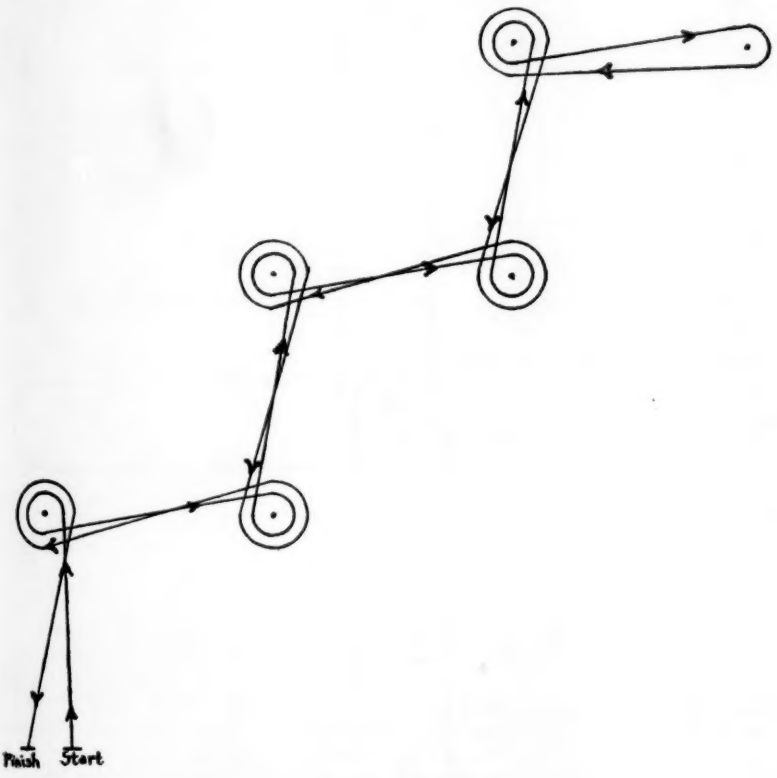

FIGURE I

2. *Boomerang, to the Right.*—Indian clubs are placed 15 feet out from the center of a jumping standard, forming a cross. The pupil follows the course as shown in Figure II, making quarter right turns at the center and half right turns around the Indian clubs. The pupil's score is the time taken to run the course.

3. *Boomerang, to the Left.*—This test is identical to the boomerang to the right, except that the course is run to the left instead of to the right.

4. *Dodge Run.*—(See McCloy).[6]

5. *40-Yard Maze Run.*—[1]Three rows of benches are placed 9 feet apart as indicated in Figure III. The pupil follows the marked course and returns to the starting line. The time taken to run the course is the pupil's score.

6. *Gauntlet Dodge Run.*—Two rows of six boys each are placed 9 feet apart facing the starting line. The boys are spaced 6 feet apart in each row. The row

to the right begins 11 feet from the starting line and the row to the left, 8 feet from the starting line. The pupil runs between the two lines, and during the course of his run 3 men at different intervals step inward with the inside foot and hold the inside arm out parallel to the floor causing the pupil to dodge around. The men that are to block are signaled by the tester with numbers which are held up behind the pupil's back. As the pupil completes his run through the gauntlet he touches a line which is 6 feet beyond row two, and returns around the outside of the gauntlet to the starting line.

The pupil's score is the time taken to complete the trip.

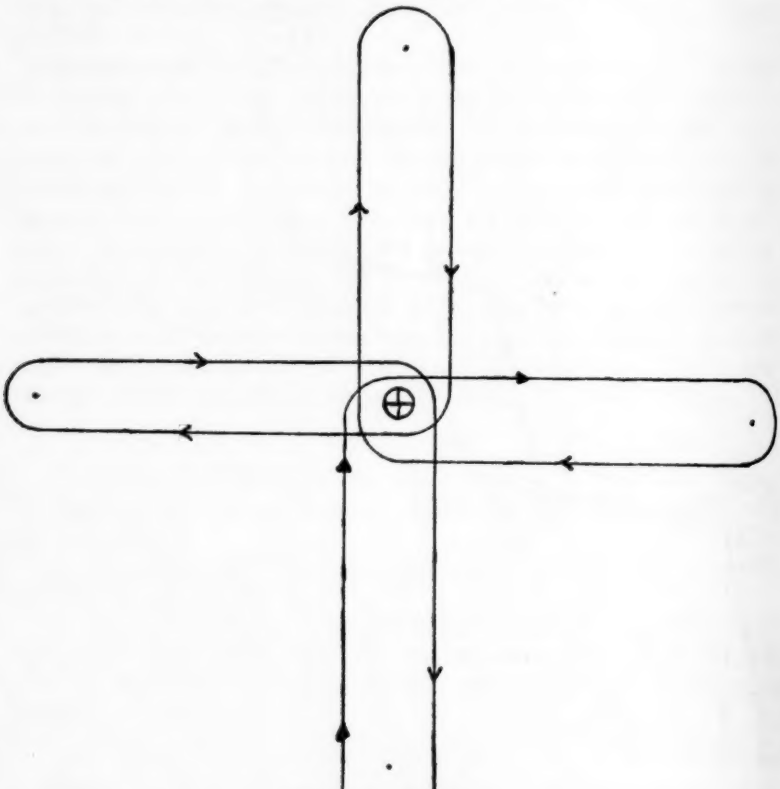

FIGURE II

7. *Zig-Zag Side Step.*—[5]Four hurdles are arranged in front of a 6-foot starting line as shown in Figure IV. The pupil starts at one end of the starting line and side steps through the course as marked. The pupil's score is the time taken to complete the circuit. (Note: The pupil runs from the start to the first hurdle and around the last hurdle, then from the first hurdle to the finish.)

8. *Zig-Zag Run.*—This test is arranged the same as the zig-zag side step. The pupil runs between the hurdles instead of side-stepping and the test is scored in the same manner.

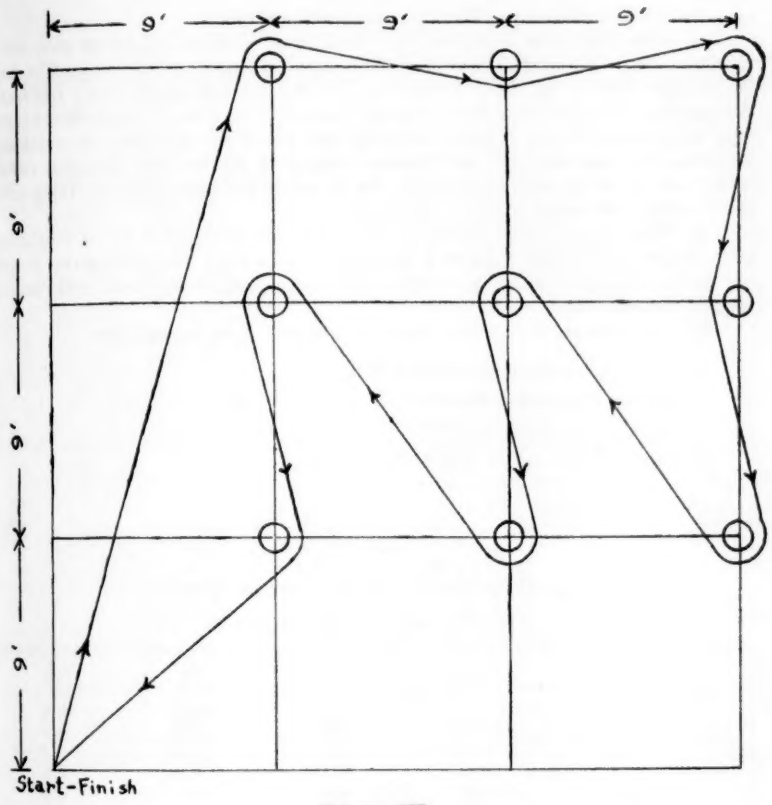

FIGURE III

9-10. *8- and 15-Foot Shuttle Runs.*—These tests are run the same as the 30-foot shuttle run except that the lines are placed 8 and 15 feet apart respectively instead of 30 feet.

11. *30-Foot Shuttle Run.*—[3, 5]Two lines are drawn on the floor 30 feet apart and parallel to each other. The pupil starts back of one of the lines and makes three complete trips, touching outsides of the line with the feet only.

The pupil's score is the time taken to make the three round trips.

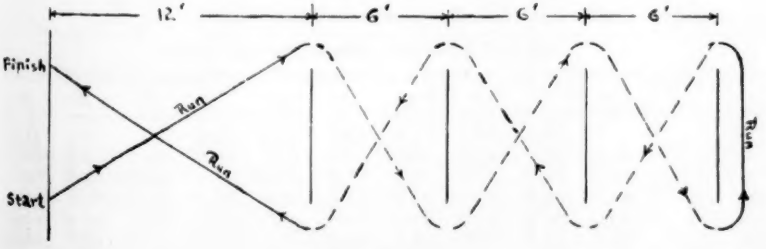

FIGURE IV

12. *Howe Test.*—(See Alden, Horton, and Caldwell.[1])

13. *Auto Tire Test.*—Ten tires are used. Five tires are placed in each row; the rows are 4 feet apart. The tires are placed 6 feet apart in each row. The row to the right starts 3 feet from the starting line and the row to the left, 6 feet from the starting line. The pupil steps with his right foot into the first tire in the right row, then steps with his left foot into the first tire of the left row. He continues stepping first right then left until he has stepped in all the tires. He then makes a full turn to the left and returns over the course in the same manner. The pupil's score is the time taken to make the trip.

14. *Figure Eight.*—The framework for the figure eight test is set up by placing four Indian clubs in the form of a rectangle 12 x 18 feet. The pupil starts at one end of the rectangle and makes a figure eight by crossing in the center and running around the end clubs.

The pupil's score is the time taken to complete three round trips.

15. *Cross Hop.*—(See McCloy[6]).

16. *Burpee Test.*—(See McCloy[6]).

17. *Iowa Brace.*—(See McCloy[6]).

18. *Johnson Test.*—(See McCloy[6]).

TABLE A

30-Foot Shuttle Run—Seventh Grade

.114 x T-Score for Time in Seconds

	.0	.2	.4	.6	.8
12.				11.3	10.9
13.	10.3	10.1	9.8	9.3	9.0
14.	8.5	8.2	8.0	7.7	7.5
15.	7.3	7.1	6.6	6.3	6.0
16.	5.6	5.4	5.2	5.1	4.9
17.	4.8	4.6	4.4	4.3	4.1
18.	3.9	3.8	3.6	3.6	3.5
19.	3.4	3.4	3.3	3.2	3.2
20.	3.1	3.0	2.9	2.8	2.7
21.	2.6	2.4	2.3	2.2	2.1
22.	2.0	1.9	1.8	1.7	1.5
23.	1.5	1.4	1.3	1.1	1.0

TABLE B

Zig-Zag Side Step—Seventh Grade

.227 x T-Score for Time in Seconds +11.6

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
7.			34.3	34.1	33.6	33.3	33.0	32.7	32.3	31.9
8.	31.6	31.3	30.9	30.6	30.2	29.9	29.6	29.2	28.9	28.5
9.	28.2	27.8	27.5	27.2	26.8	26.5	26.1	25.8	25.5	25.1
10.	24.8	24.5	24.1	23.8	23.4	23.0	22.3	22.1	21.6	21.1
11.	20.7	20.5	20.2	20.0	19.8	19.6	19.3	19.1	18.9	18.6
12.	18.4	18.2	18.0	17.7	17.5	17.3	17.1	16.8	16.6	16.3
13.	16.1	16.0	15.7	15.5	15.2	15.0	14.8	14.6	14.3	14.1

TABLE C

40-YARD MAZE RUN—SEVENTH GRADE
.428 x T-Score for Time in Seconds

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
11.		42.8	41.5	40.3	39.0	37.9	36.8	36.0	34.7	33.4
12.	32.6	31.3	30.4	29.6	28.7	27.8	27.0	26.1	24.8	24.0
13.	23.3	22.7	22.3	21.8	21.2	20.6	20.1	19.7	19.3	18.8
14.	18.4	18.0	17.7	17.4	17.1	16.8	16.6	16.3	16.0	15.7
15.	15.4	15.1	14.9	14.6	14.3	14.0	13.7	13.4	13.1	12.9
16.	12.6	12.3	12.0	11.7	11.4	11.1	10.8	10.5	10.3	10.0
17.	9.7	9.4	9.1	8.8	8.5	8.3	8.0	7.7	7.4	7.2
18.	6.9	6.6	6.3	6.0	5.7	5.4	5.1	4.8	4.6	4.3

TABLE D

30-FOOT SHUTTLE RUN—EIGHTH GRADE
.249 x T-Score for Time in Seconds

	.0	.2	.4	.6	.8
12.				24.7	23.9
13.	22.9	22.2	21.5	20.5	19.7
14.	20.4	18.0	17.5	17.0	16.5
15.	16.0	15.5	14.5	13.7	13.2
16.	12.2	11.8	11.5	11.1	10.7
17.	10.5	10.0	9.7	9.4	9.0
18.	8.6	8.2	7.9	7.8	7.7
19.	7.5	7.4	7.2	7.1	7.0
20.	6.9	6.6	6.4	6.1	5.9
21.	5.6	5.4	5.1	4.9	4.6
22.	4.4	4.1	3.9	3.6	3.4
23.	3.2	3.0	2.7	2.5	2.2

TABLE E

ZIG-ZAG SIDE STEP—EIGHTH GRADE
.293 x T-Score for Time in Seconds

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
7.			29.3	29.0	28.5	28.0	27.6	27.3	26.7	26.3
8.	25.8	25.4	24.9	24.5	24.1	23.6	23.2	22.7	22.3	21.9
9.	21.4	21.0	20.5	20.2	19.7	19.2	18.8	18.4	17.9	17.5
10.	17.0	16.6	16.1	15.7	15.3	14.7	13.8	13.5	12.9	12.3
11.	11.7	11.4	11.1	10.9	10.6	10.3	10.0	9.7	9.4	9.1
12.	8.8	8.5	8.2	7.9	7.6	7.3	7.0	6.7	6.5	6.2
13.	5.9	5.6	5.3	5.0	4.7	4.4	4.1	3.8	3.5	3.2

TABLE F

LOOP-THE-LOOP—EIGHTH GRADE
.216 x T-Score for Time in Seconds +12.1

	.0	.2	.4	.6	.8
18.					33.7
19.	33.3	32.4	31.6	30.9	30.3
20.	29.4	28.7	28.1	27.2	26.6
21.	26.4	25.9	25.7	25.3	24.9
22.	24.6	24.2	24.0	23.8	23.6
23.	23.3	23.1	22.7	22.3	22.1
24.	22.0	21.8	21.4	21.2	21.0
25.	20.9	20.5	20.5	20.4	20.2
26.	20.0	19.7	19.6	19.4	19.4
27.	19.3	19.2	19.1	19.0	19.0
28.	18.9	18.8	18.7	18.6	18.5
29.	18.4	18.2	18.0	17.7	17.5
30.	17.3	17.1	16.9	16.6	16.4
31.	16.2	16.0	15.8	15.6	15.3
32.	15.1	14.9	14.7	14.5	14.3

TABLE G

30-FOOT SHUTTLE RUN—NINTH GRADE
.252 x T-Score for Time in Seconds

	.0	.2	.4	.6	.8
12.				24.9	24.2
13.	23.2	22.4	21.6	20.6	19.9
14.	18.9	18.1	17.6	17.1	16.6
15.	16.1	15.6	14.6	13.8	13.3
16.	12.3	12.0	11.6	11.2	10.8
17.	10.6	10.1	9.8	9.4	9.1
18.	8.7	8.3	8.0	7.9	7.8
19.	7.6	7.5	7.3	7.2	7.1
20.	7.0	6.7	6.4	6.2	5.9
21.	5.7	5.4	5.2	4.9	4.7
22.	4.4	4.2	4.0	3.6	3.4
23.	3.2	3.0	2.8	2.5	2.3

TABLE H

ZIG-ZAG RUN—NINTH GRADE

.221 x T-Score for Time in Seconds +13.6

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
7.		35.7	35.4	35.0	34.3	33.9	33.5	33.0	32.6	32.1
8.	31.7	31.2	30.8	30.4	29.9	29.5	29.0	28.6	28.2	27.7
9.	27.3	26.8	26.4	26.0	25.7	25.3	25.1	24.6	24.4	24.0
10.	23.7	23.3	23.1	22.6	22.4	22.2	21.8	21.5	21.3	21.1
11.	20.9	20.7	20.4	20.2	20.0	19.8	19.6	19.1	18.9	18.7
12.	18.5	18.2	19.0	17.8	17.6	17.3	17.1	16.9	16.7	16.5
13.	16.2	16.0	15.8	15.6	15.4	15.1	14.9	14.7	14.5	14.3

TABLE I

BOOMERANG, RIGHT—NINTH GRADE

.256 x T-Score for Time in Seconds

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
10.	25.6	25.3	24.8	24.3	23.9	23.5	23.0	22.7	22.2	21.7
11.	21.5	21.0	20.4	20.2	19.7	19.2	18.9	18.4	18.1	17.6
12.	17.4	17.1	16.6	16.4	16.1	15.8	15.3	15.1	14.8	14.3
13.	14.1	13.5	13.3	13.0	12.5	12.3	12.0	11.5	11.2	11.0
14.	10.5	10.2	10.0	9.8	9.7	9.6	9.5	9.2	9.1	8.9
15.	8.7	8.6	8.4	8.2	7.9	7.8	7.7	7.5	7.3	7.2
16.	7.1	7.0	7.0	6.8	6.8	6.6	6.6	6.5	6.4	6.3
17.	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.5
18.	5.4	5.3	5.2	5.1	5.0	5.0	4.9	4.8	4.7	4.6

Coefficient Performance Chart

By Hilary W. Jefferson
Nathaniel Hawthorne School, Yonkers, New York

IT IS a far cry from sports competition between pupils of the same grade and pupils of the same coefficient. For years many of those engaged in physical education have felt the general unfairness of competition in all scholastic athletic sports. What incentive was offered to make the boy aware of the possibilities of physical growth? What could the director of physical education do to see that a boy with whom he is entrusted gets the most out of his formative years, the years in which it is possible to develop the skills that now and later will give him wholesome enjoyment and recreation?

Certainly unfair competition will not lead to success, and if the boy is constantly unsuccessful, the incentive to go on trying is not only nil, but the quality of perseverance is destroyed. "Nothing succeeds like success."

The classification of all boys in our junior high school into one of three groups—*A*, *B*, *C*—according to age, height, and standing broad jump did much to solve our problem. There remained, however, the problem of the disparity between pupils at the extremes of each group. For example, in the *B* group (31 to 40), there will probably be as many boys at 31 as at 40. Certainly the competition is unfair for them, though not as unfair as if they were competing against boys with a coefficient of 50.

Although we compiled scoring charts showing the number of points earned for each performance, there was a constant request from the individual boy as to what *he* should be able to do. The boy having a coefficient of 31 could see that he shouldn't be expected to attain what a boy with a coefficient of 40 should attain.

Over a period of several years we have kept records of the achievements of every boy in ten athletic events, and from these results we compiled the coefficient-performance charts which show the boy at a glance the lowest, the median, and the best attainment of the boys of his exact coefficient. With this scale, he can compete against marks made by *boys like himself*.

No spikes were allowed for any of the events. Three trials were allowed in all track and field events with the best effort being recorded. Boys with coefficients up to 31 used a 5-lb. shot, and those over that number an 8-lb shot. The baserun was timed on a playground diamond with 30-foot baselines. Twenty shots were allowed each boy in foul shooting. When shooting against time, the boy made his first shot from

the foul line, followed in on that shot, and then took as many shots as he could during the one-minute time limit from wherever he happened to recover the ball.

COEFFICIENT CHART

NATHANIEL HAWTHORNE SCHOOL

	Age	Height	Broad Jump*	
1.	11–11/3	51	4′ 6″–4′ 9″	1
2.		52	4′ 10″–5′	2
3.	11/4–11/7	53	5′ 1″ –5′ 3″	3
4.			5′ 4″–5′ 6″	4
5.	11/8–11/11	54	5′ 7″ –5′ 9″	5
6.	12–12/3	55		6
7.	12/4–12/7	56–57	5′ 10″–6′ 3″	7
8.	12/8–12/11	58	6′ 4″ –6′ 6″	8
9.	13–13/3	59	6′ 7″ –6′ 9″	9
10.	13/4–13/7	60	6′ 10″–7′	10
11.	13/8–13/11	61–62	7′ 1″ –7′ 3″	11
12.	14–14/3	63	7′ 4″ –7′ 6″	12
13.	14/4–14/7	64–65	7′ 7″ –7′ 9″	13
14.	14/8–14/11	66	7′ 10″–8′	14
15.	15–15/7	67	8′ 1″ –8′ 3″	15
16.	15/8–15/11	68	8′ 4″ –8′ 5″	16
17.	16–16/3		8′ 6″ –8′ 8″	17
18.	16/4–16/11	69	8′ 9″ –8′ 11″	18
19.	17–17/3	70	9′ –9′ 2″	19
20.	17/4–17/7	71	9′ 3″ –9′ 5″	20

* The standing broad jump was used instead of weight because experience has shown the author that an overweight boy wlil be pushed into a classification where he has no chance of competition. An overweight boy will usually not do so well in the standing broad jump and this will keep him down where he has some chance of success.

50-YARD DASH

(Seconds and Tenths)

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	9.4	8.4	7.6	32	9.8	7.1	6.3
14	9.4	8.3	7.5	33	8.9	7.1	6.3
15	9.4	8.2	7.4	34	8.9	7.1	6.3
16	9.4	8.1	7.3	35	8.8	7	6.3
17	9.4	8	7.2	36	8.8	7	6.3
18	9.4	8	7.1	37	8.7	7	6.2
19	9.3	7.9	7	38	8.7	7	6.2
20	9.3	7.8	6.9	39	8.6	7	6.2
21	9.3	7.7	6.9	40	8.5	6.9	6.2
22	9.3	7.6	6.8	41	8.4	6.9	6.2
23	9.2	7.6	6.7	42	8.3	6.9	6.2
24	9.2	7.5	6.7	43	8.2	6.9	6.2
25	9.2	7.4	6.6	44	8.1	6.9	6.2
26	9.1	7.4	6.5	45	8	6.9	6.2
27	9.1	7.3	6.5	46	7.8	6.9	6.2
28	9.1	7.3	6.5	47	7.6	6.9	6.3
29	9.1	7.2	6.4	48	7.4	6.8	6.3
30	9	7.2	6.4	49	7.2	6.8	6.3
31	9	7.2	6.4	50	7.1	6.8	6.3

FOOTBALL PASS FOR DISTANCE
(In Yards)

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	14	20	25	32	16	25	33
14	14	20	25	33	16	25	34
15	14	20	25	34	17	26	35
16	14	20	25	35	17	26	36
17	14	21	25	36	17	27	37
18	14	21	25	37	18	28	37
19	14	21	25	38	18	29	38
20	14	21	26	39	18	30	39
21	14	21	26	40	19	31	40
22	14	21	26	41	19	32	41
23	14	22	27	42	20	33	42
24	14	22	27	43	20	34	43
25	14	22	28	44	21	35	44
26	15	22	29	45	22	36	45
27	15	23	30	46	23	37	46
28	15	23	30	47	24	38	48
29	15	23	31	48	25	39	49
30	16	24	32	49	26	40	50
31	16	24	32	50	27	41	51

CHINNING

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	H*	2	13	32	H	7	15
14	H	2	13	33	H	7	15
15	H	2	13	34	½	7	15
16	H	3	13	35	½	7	15
17	H	3	13	36	½	7	15
18	H	3	13	37	½	7	15
19	H	4	14	38	½	7	15
20	H	4	14	39	¾	8	15
21	H	4	14	40	¾	8	15
22	H	5	14	41	¾	8	15
23	H	5	14	42	¾	8	15
24	H	5	14	43	¾	8	16
25	H	5	14	44	1	8	16
26	H	5	14	45	1	8	16
27	H	6	14	46	1	8	16
28	H	6	15	47	1	8	15
29	H	6	15	48	1	7	15
30	H	6	15	49	1	7	15
31	H	6	15	50	1	6	14

* H—able to hang only.

Standing Broad Jump

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	4′ 8″	5′ 3″	6′ 6″	32	5′ 2″	6′ 9″	8′
14	4′ 8″	5′ 5″	6′ 7″	33	5′ 2″	6′ 9″	8′
15	4′ 8″	5′ 6″	6′ 9″	34	5′ 3″	6′ 10″	8′
16	4′ 8″	5′ 7″	6′ 10″	35	5′ 4″	6′ 10″	8′ 1″
17	4′ 8″	5′ 8″	7′	36	5′ 4″	6′ 11″	8′ 2″
18	4′ 10″	5′ 9″	7′ 1″	37	5′ 5″	6′ 11″	8′ 2″
19	4′ 10″	5′ 10″	7′ 2″	38	5′ 6″	7′	8′ 2″
20	4′ 10″	5′ 11″	7′ 3″	39	5′ 7″	7′	8′ 3″
21	4′ 10″	6′	7′ 4″	40	5′ 8″	7′ 1″	8′ 3″
22	4′ 11″	6′ 1″	7′ 5″	41	5′ 9″	7′ 1″	8′ 3″
23	4′ 11″	6′ 2″	7′ 6″	42	5′ 10″	7′ 2″	8′ 4″
24	4′ 11″	6′ 3″	7′ 7″	43	5′ 11″	7′ 2″	8′ 4″
25	4′ 11″	6′ 3″	7′ 7″	44	6′	7′ 3″	8′ 4″
26	5′	6′ 4″	7′ 8″	45	6′ 1″	7′ 3″	8′ 4″
27	5′	6′ 5″	7′ 9″	46	6′ 3″	7′ 4″	8′ 4″
28	5′	6′ 6″	7′ 9″	47	6′ 4″	7′ 4″	8′ 4″
29	5′ 1″	6′ 7″	7′ 10″	48	6′ 5″	7′ 5″	8′ 5″
30	5′ 1″	6′ 7″	7′ 10″	49	6′ 7″	7′ 5″	8′ 6″
31	5′ 1″	6′ 8″	7′ 11″	50	6′ 8″	7′ 6″	8′ 7″

Running Broad Jump

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	7′ 6″	10′ 6″	12′ 4″	32	8′ 8″	12′	15′ 6″
14	7′ 6″	10′ 6″	12′ 5″	33	8′ 9″	12′ 1″	15′ 9″
15	7′ 6″	10′ 6″	12′ 6″	34	8′ 10″	12′ 2″	15′ 11″
16	7′ 6″	10′ 6″	12′ 8″	35	8′ 11″	12′ 4″	16′
17	7′ 6″	10′ 6″	12′ 9″	36	9′	12′ 6″	16′ 2″
18	7′ 7″	10′ 7″	12′ 10″	37	9′ 1″	12′ 8″	16′ 4″
19	7′ 7″	10′ 7″	13′	38	9′ 2″	12′ 10″	16′ 6″
20	7′ 8″	10′ 8″	13′ 2″	39	9′ 4″	13′	16′ 7″
21	7′ 8″	10′ 9″	13′ 4″	40	9′ 6″	13′ 1″	16′ 8″
22	7′ 9″	10′ 10″	13′ 6″	41	9′ 8″	13′ 2″	16′ 9″
23	7′ 11″	10′ 11″	13′ 8″	42	9′ 10″	13′ 3″	16′ 10″
24	8′	11′	13′ 10″	43	10′	13′ 4″	16′ 11″
25	8′ 1″	11′ 1″	14′ 1″	44	10′ 3″	13′ 5″	17′
26	8′ 2″	11′ 2″	14′ 3″	45	10′ 6″	13′ 6″	17′ 1″
27	8′ 3″	11′ 4″	14′ 6″	46	10′ 9″	13′ 7″	17′ 2″
28	8′ 4″	11′ 6″	14′ 9″	47	11′	13′ 8″	17′ 3″
29	8′ 5″	11′ 8″	14′ 11″	48	11′ 3″	13′ 9″	17′ 5″
30	8′ 6″	11′ 10″	15′	49	11′ 6″	13′ 10″	17′ 9″
31	8′ 7″	11′ 11″	15′ 3″	50	11′ 9″	13′ 11″	17′ 11″

BASKETBALL FOUL SHOTS

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	2	5	10	32	1	6	13
14	2	5	10	33	1	6	13
15	2	5	10	34	2	6	13
16	2	5	11	35	2	6	13
17	2	5	11	36	2	6	13
18	2	5	11	37	2	7	13
19	1	5	11	38	2	7	13
20	1	5	11	39	3	7	13
21	1	5	12	40	3	7	13
22	1	5	12	41	3	7	13
23	1	5	12	42	3	7	13
24	1	5	12	43	4	8	13
25	1	5	12	44	4	8	13
26	1	5	12	45	4	8	13
27	1	5	12	46	5	8	14
28	1	5	12	47	5	8	14
29	1	6	12	48	6	9	14
30	1	6	13	49	6	9	14
31	1	6	13	50	7	9	14

BASKETBALL GOAL SHOOTING AGAINST TIME
(One Minute)

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	7	7	13	32	4	10	22
14	7	7	14	33	4	11	22
15	5	7	14	34	5	11	23
16	5	7	15	35	5	11	23
17	4	7	15	36	5	12	24
18	4	7	16	37	5	12	24
19	3	7	16	38	6	13	25
20	3	8	17	39	6	13	25
21	3	8	17	40	6	14	25
22	3	8	18	41	6	14	26
23	3	8	18	42	7	15	26
24	3	8	18	43	7	15	26
25	3	9	19	44	8	16	27
26	3	9	19	45	8	16	27
27	3	9	19	46	9	17	27
28	3	9	20	47	9	17	28
29	3	10	20	48	9	18	28
30	4	10	21	49	10	18	28
31	4	10	21	50	10	19	29

Playground Baseball Base Run
(Seconds and Tenths)

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	10.6	9.8	9.2	32	10.7	9.2	7.5
14	10.8	9.8	9.1	33	10.6	9.2	7.6
15	10.8	9.8	9	34	10.6	9.2	7.6
16	10.9	9.8	8.8	35	10.6	9.2	7.6
17	10.9	9.6	8.7	36	10.6	9.2	7.6
18	10.9	9.6	8.5	37	10.5	9.2	7.7
19	11	9.6	8.4	38	10.5	9.1	7.7
20	11.1	9.6	8.3	39	10.5	9.1	7.8
21	11.1	9.6	8.2	40	10.5	9.1	7.8
22	11.1	9.6	8.1	41	10.4	9	7.9
23	11	9.6	8	42	10.4	9	8
24	11	9.4	7.9	43	10.2	9	8.1
25	10.9	9.4	7.8	44	10.1	8.9	8.2
26	10.9	9.4	7.7	45	10	8.9	8.3
27	10.9	9.4	7.7	46	10	8.9	8.4
28	10.8	9.4	7.6	47	9.9	8.8	8.5
29	10.8	9.4	7.6	48	9.8	8.8	8.6
30	10.8	9.4	7.6	49	9.7	8.8	8.6
31	10.7	9.2	7.5	50	9.6	8.8	8.6

Football Punt for Distance

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	17	19	25	32	11	23	32
14	17	19	25	33	11	23	33
15	17	19	26	34	11	24	33
16	16	19	26	35	11	24	34
17	16	19	26	36	11	25	34
18	15	19	26	37	12	25	35
19	14	19	27	38	12	26	35
20	13	19	27	39	13	26	36
21	12	20	27	40	13	27	36
22	12	20	28	41	14	27	37
23	11	20	28	42	14	28	38
24	11	20	28	43	15	29	39
25	10	21	29	44	15	29	39
26	10	21	29	45	16	30	40
27	10	21	30	46	16	31	41
28	10	22	30	47	17	31	41
29	10	22	31	48	17	32	42
30	10	22	31	49	18	33	42
31	10	23	32	50	19	34	43

SHOT-PUT

Coef.	Low	Med.	High	Coef.	Low	Med.	High
13	12′ 2″	20′ 1″	23′ 3″	32	12′ 6″	21′	29′ 3″
14	12′ 3″	20′ 3″	23′ 6″	33	13′	21′ 6″	30′ 6″
15	12′ 4″	20′ 5″	24′	34	13′ 8″	22′ 3″	31′ 10″
16	12′ 5″	20′ 6″	24′ 5″	35	14′ 4″	22′ 9″	33′
17	12′ 6″	20′ 8″	25′	36	15′	23′ 6″	34′
18	12′ 7″	20′ 10″	25′ 6″	37	15′ 7″	24′ 3″	34′ 11″
19	12′ 8″	21′	26′	38	16′ 4″	24′ 9″	35′ 3″
20	12′ 9″	21′ 5″	26′ 8″	39	17′	25′ 6″	36′ 4″
21	12′ 10″	21′ 7″	27′ 8″	40	18′	26′	36′ 9″
22	12′ 11″	22′	28′ 2″	41	18′ 6″	26′ 9″	37′ 3″
23	13′	22′ 3″	29′	42	19′ 6″	27′ 4″	37′ 9″
24	13′ 3″	22′ 6″	29′ 9″	43	20′ 6″	28′	38′
25	13′ 6″	23′	30′ 10″	44	21′ 6″	28′ 7″	38′ 6″
26	13′ 9″	23′ 6″	32′	45	22′ 6″	29′ 4″	38′ 9″
27	14′	24′	33′	46	23′ 6″	30′ 1″	38′ 10″
28	14′ 3″	24′ 5″	34′ 5″	47	24′ 6″	30′ 6″	39′
29	14′ 6″	25′	35′ 6″	48	25′ 8″	31′ 3″	38′ 11″
30	14′ 9″	25′ 6″	37′	49	26′ 9″	32′	38′ 10″
*31	12′	20′ 4″	28′	50	28′	32′ 4″	38′ 9″

* The drop in distance at this point is due to the fact that while the 5-lb. shot was used with boys having coefficients of 13-30, inclusive, the 8-lb. shot was used with boys having coefficients of 31 and up.

BOOK REVIEWS

INTRODUCTION TO COMMUNITY RECREATION. Edited by George D. Butler. (New York: McGraw-Hill Book Co., 1940) 547 pages, $3.50.

Introduction to Community Recreation attempts to interpret community recreation, its significant functions, objectives, program content, methods of operation, and relationship. It does not deal as fully with the theory and significance of recreation, with recreation activities and leadership methods, recreation areas and facilities, or the content and conduct of other parts of the recreation program as previous books.

In Part I, the agencies which provide recreation are discussed, its relation to the community as a municipal function is shown, and the historical development of recreation is traced from its earlier beginnings to the depression.

Part II deals more specifically with leadership. Qualifications of leaders through preliminary training and in-service training, and the sphere of the volunteer leader in the recreation department are discussed.

Part III indicates how areas and facilities may become an integral part of the city structure. One chapter is devoted to special recreational areas.

Part IV turns to activities and program planning and is pregnant with suggestions for the organizing and conducting of recreation activities.

Part V, entitled "The Operation of Areas and Facilities," deals with the routine of operation and administration. Playground features and services are extended to many new areas and Part VI brings together such services as arts and crafts, athletics and sports, drama, music, nature, gardening, and outing activities.

The final part of the book, preceding a well-ordered bibliography, is devoted to organization and administration problems.

HAROLD W. COPP, Ph.D.
University of Michigan

A MODERN PHYSICAL EDUCATION PROGRAM FOR BOYS AND GIRLS. Vaughn S. Blanchard and Laurentine B. Collins. (New York: A. S. Barnes and Co., 1940) 350 pages, $2.00.

The average high school teacher is aware of the fact that the nature of the secondary school population and the American pattern of living in a democracy has definitely changed. Still, the great majority of boys and girls who now attend the secondary schools in the United States are getting, on the whole, an education that is too much concerned with facts and too little concerned with values.

Here is neither the place nor the time to present any of the abundant evidence why the typical, half-century-old high school program must be carefully examined and re-evaluated in the light of up-to-date realistic objectives. The increasing trend of thinking teachers to accept this challenge and responsibility is distinctly hopeful.

A Modern Physical Education Program for Boys and Girls is typical of the trend. This reconstructed curriculum represents the thought, energy, and interest of over one hundred fifty teachers in the Detroit schools working democratically together for more than six years, clarifying their thinking, analyzing their point of view, and evaluating their current philosophy of education. Naturally, of great import to the numerous functioning committees during the process of construction were the varying needs, interests, and abilities of the boys and girls for whom this program was being built.

The book is divided into the following chapters: An Approach to Curriculum Building, Organization and Administration, The Gymnasium Program, Dance, The Playground Program, The Swimming Program, The Health Program, Supplementary Materials. Especially significant are the first and last chapters. These discuss the underlying philosophy and the practical procedures and principles that the teachers of Detroit have worked out and by which they have guided their thinking during the fluid process of curriculum construction.

Throughout the program the reader can recognize that a determined effort was made to organize and present the material in a terse and succinct way. Careful perusal will also show that no two units in the book are exactly alike in completeness, in richness of suggestion, and in possibilities for integration.

The book provides for the profession a handbook and manual which might well be used to true-up any program, and which will not only disclose weak points in other programs so compared but also suggest a remedy. Selected references, scoring devices, etc., are included in the supplementary material.

No review can do justice to this comprehensive publication. It will serve teachers, teachers-in-training, and physical education students admirably.

The lone criticism this reviewer can direct against this practical and useful undertaking is that the authors should have included some of the typical pitfalls the problems that their committees had to contend with and overcome.

M. Donald Adolph
Thomas Jefferson High School
Brooklyn, New York

You Can Stay Young. Daniel W. Josselyn. (New York: Frederick A. Stokes Company, 1939) 143 pages, $1.50.

"To live is a very great experience" says the author in his introduction. But the science of successful living should be taught to youth in order that youth may not be lost too soon. Youth is a physical condition not dependent merely upon chronological age.

We have learned how to make children taller, broader, stronger, healthier —the author points out—now we must learn how to help the adult keep growing. The best way to do this is through education in better health habits. If students of school age are taught how to keep young when school days are over, the value of education will be thereby greatly enhanced, is the opinion of this writer after twenty years of experience as a hygienist.

Continued growth — "youth-growth" —may be aided through delectable diets. One does not need to eat unenjoyable foods. We must, however, teach youth to discriminate in food selection. Not all spinach is rich in vitamin C nor all lettuce an abundant supplier of vitamin A. Apples, cereals, and other every-day foods vary greatly in their health-giving values, yet these facts are not recognized by everyone today. "We have not applied our new food knowledge very well even to childhood as yet," the author says.

How to be sure of filling the daily vitamin and mineral needs for youthful maintenance of health is very simply told. If students could be established upon a daily routine of one quart milk, orange or tomato juice, vitamin concentrates of known value, and green vegetables, the foundation for health and vigor would be laid. Calorie-counting is not given much thought in youth, yet it is then that the lessons of food's effect upon health should be learned for life. "Broaden your food education."

Keeping the colon active through drinking plenty of water, eating laxative foods, and forming regular habits is very important. Just how best to do this is discussed. A vitality-building program, either for young men or for young women, means a proper amount of good food, rest, exercise, and healthy emotions. The chemistry of emotion discussed in an interesting way shows how the mind influences the body and

its functions. Indeed the chapter entitled "Glandular Youth" is full of inspiration for teachers who may find themselves in need of recapturing some of the lost art of being carefree and happy.

BEULAH FRANCE, R.N.
New York City

VISUAL AIDS FOR TEACHING SPORTS. Therese Powdermaker. (New York: A. S. Barnes & Company, 1940) 26 plates, $1.00.

The old adage that one picture is worth a dozen words has been revived in the production of this book.

Figures demonstrate techniques in a clear and interesting manner so that students can see actual positions taken in the sport being studied. The twenty-six large charts are bound in such a way as to be usable for bulletin boards. Sports covered are: archery, badminton, basketball, boating, bowling, deck tennis, diving, fencing, golf, handball, hockey, horseshoes, lacrosse, riding, shuffleboard, skating, skiing, soccer, softball, swimming, table tennis, tennis, track, and volleyball.

These visual aids should give maximum assistance to the student and teacher.

HAROLD W. COPP, Ph.D.
University of Michigan

MODERN CAMPING GUIDE. George W. Martin. (New York: D. Appleton-Century Company, 1940) 349 pages, $2.50.

Among the publications designed to supply valuable information to those interested in the rapidly spreading camping movement and who wish to (do things for themselves), this text deserves a prominent place.

The author, an experienced and intelligent camper, has selected and summarized a satisfactory list of camping fundamentals. He has shown commendable restraint in temperate statements and in avoiding the temptation to elaborate unduly on any favorite aspect. The absence of the dogmatic attitude is indicated by the lack of "must" and "should," too often used by those who pose as authorities. He manifests a very sane attitude between the too-primitive type of camping and the deluxe equipment. His philosophy may be summarized as "keep agreeably warm, be well fed, have a good night's rest, and keep reasonably clean."

The first sixty-four pages treat general topics, while subsequent chapters are devoted to tents and shelters, packs, bedding and sleeping equipment, camp stoves, open fires, provisions, cooking utensils and camp cooking, clothing, miscellaneous equipment, insects, ski-touring, safety, and first aid.

A question might be raised regarding his statement that "literature on this subject is rather meager." His bibliography, apart from government publications, is limited to one page (sixteen titles). Periodical literature, in which much of the best up-to-date information is contained, seems to be disregarded entirely.

In format the book is commendable. Adequate subject headings, eighty-three line drawings, and a satisfactory index facilitate a ready use of the text.

G. B. AFFLECK
Springfield College

RIDING LOGIC. Major i. R. Wilhelm Museler. Translated from the German by F. W. Schiller. (London: Methuen & Co. Ltd., 1937) 184 pages, $5.00.

Riding Logic is ideal to use where riding is a branch of the physical education program. It clearly explains and emphasises the need of relaxation, coordination, and muscle control when riding. Particular point is made of the back. The Germans have been very successful in riding competitions, especially in the last Olympics. *Riding Logic* explains the German principles. Much of it disagrees with the Italian theories as expounded by Piero Santini.

The book has five divisions: the training of the rider, the schooling of the horse, the lessons, exercises for the further training of rider and horse, tackle.

The first part explains in detail the

position of the rider, including balance, suppleness, following the movement of the horse, and back-muscle action. This is followed by explanation of the rider's application of the aids, or means of influencing the horse, through his legs, weight, reins, and back-muscle action.

"The Schooling of the Horse" considers the psychology of the horse, how to criticize and correct a horse's balance, collection, relaxation, and the curing of disobediences.

"Lessons" covers detailed work for improving both horse and rider, including collection and extension, bending and flexing, turns, pivots and two-track, etc.

"Exercises for the Further Training of Rider and Horse," explains the benefits of, and gives instruction in, solo riding, show riding, cross-country riding, jumping and hunting.

The final part on tackle gives briefly the use of bridle, saddles, bandages, auxiliary reins, the whip, spurs, and the lunge.

The book is illustrated with excellently chosen photographs and many pointed diagrams that make the text clear. It can be used with advantage as a sound basis for beginners and also offers instruction for the most advanced riders.

PHYLLIS LININGTON
Miss Linington's Stables
Milton, Mass.

ENCYCLOPEDIA OF SPORTS. Frank G. Menke. (New York: F. G. Menke, Inc., 1939) 319 pages, $2.00.

Frank G. Menke has been a sports writer for many years, and his *All Sports Record Book* has become a standard work for athletic and sporting records. It would be expected, then, that the present work would be a contribution of genuine merit. The lack of good, authoritative encyclopedia in these fields has been felt for many years. We hoped, at first, this lack was to be filled by this book. The truth of the matter is, that the work is not an encyclopedia at all. It takes a good deal more than three hundred and twenty pages for a true encyclopedia in the field of sports. The last true one in English, dated 1911-1912, was in four large volumes. Sports have developed enormously since that period.

Granting that the title is a misnomer, which it is, an examination of the material included reveals some interesting, if startling information. For instance, Philadelphia's Athletics are not listed as ever having been in the American league. Some of the conclusions he reaches as to the origin of certain sports would be more convincing had he seen fit to give documentary evidence.

Mr. Menke writes in the true slangy style of newspaper men which, while common to the sports world, does not lend itself well to encyclopedic works. There are evidences of careless work, for the proof reading is poor and simple errors are frequent. Thus, on page 64, it is indicated, although the statement is vague, that Col. Ruppert of the Yankees died on December 10, no year. Ruppert died January 13, 1939. Under boxing the first Louis-Schmeling fight is not included, although Louis' later fights, through 1938, are given.

There is an interesting list of football stadia on page 160. Unfortunately, it is open to serious criticism as to its accuracy and authority. Michigan State College and Michigan Aggies are listed as separate schools with stadia of varying size. In reality they are one and the same institution. Michigan State was Michigan Aggies—about fifteen years ago. The same is true for North Carolina State and North Carolina Aggies. Several schools listed as having stadia do not have any. For example, this reviewer knows personally that American University and George Washington University, both in Washington, D. C., do not have stadia. The former has a field, but no stands; the latter uses Griffith Stadium for its home games. One or two schools with stadia are entirely omitted. The figures given for capacity are apparently based on newspaper reports. Comparing with the list in the 1939 *World Almanac*, it is found that fifty-four stadia are listed in both. In only eleven instances do the two agree.

Menke's tabulation of the cost of sports in this country does not agree with reliable studies that have been made and, when analyzed, his figures do not come out as he says.

The *Encyclopedia of Sports* is disappointing in view of these many errors. Yet, although the articles are brief and much of the material must be considered carefully, or even checked, before acceptance, Mr. Menke does include some out-of-the-way information that does not appear elsewhere. It is not sufficient, however, nor so well prepared, in this reviewer's opinion, as to make up for the book's other deficiencies.

WILSON M. RANCK
Public Library
Rochester, New York

THE MODERN TEACHER OF PHYSICAL EDUCATION. Gertrude M. Baker. (New York: F. S. Crofts & Co., 1940) 264 pages, $2.00.

Our physical education programs have felt the impingement of the Dewey philosophy for a number of years. Difficulties are arising in developing and revising the curriculum to implement the accepted dicta of this philosophy. This book presents a re-thinking and a clear presentation of fundamental concepts, and interprets the program from the point of view of progressive education.

Chapters merge from those dealing with philosophy to the more definite problem of planning the curriculum with specific emphasis on types of teaching, and methods of teaching.

A short conclusion states the responsibility for teacher training to promulgate and maintain progressive physical education.

HAROLD W. COPP, Ph.D.
University of Michigan

YOU AND HEREDITY. Amram Scheinfeld. (New York: Frederick A. Stokes, 1939) 434 pages.

Health education teachers will eagerly welcome this work which has received high praise from outstanding authorities. Gene Weltfish, for instance, Professor of Anthropology at Columbia University in New York, goes so far as to say that "nowhere else is this material available in one source," while Dr. Morris Fishbein calls it "fascinating."

And it is just that! A book which teacher and student alike will find difficult to lay aside when once it has been opened and glanced at. For while absolutely scientifically correct—Dr. Norton D. Schweitzer of Cornell University having seen to that—it is written in a way which never permits the text to become "dry." It is addressed to "you" and is personal throughout.

How did *you* begin life? What factors decided every detail of your body and your mind? How much did your ancestors contribute? What can you—and what can you not—blame on heredity? Every student, boy or girl, at some time wonders about these things: why his nose is convex; why her eyes are blue; why indeed, she should be a girl or he a boy.

Not only are all these subjects written about here in a chatty, yet authentic style, but plain and colored photographs, charts, tables, diagrams, drawings, step-by-step development illustrations as well as amusing cartoons which stress a point are scattered profusely throughout the many pages. (Dr. Fishbein spoke of these as most important.)

Though many books have been written on heredity, this one contains not only the very latest facts and data but some unique slants and angles which will aid greatly in presenting the subject. Mating and prospective parenthood are discussed briefly, some superstitions being exploded or explained: the determination of sex by wishful thinking, for instance, and the real factors which decide this question.

The chromosomes may be thought of as "chain-gangs," the author suggests—accompanying this with a full-page illustration showing architects, engineers, masons, plumbers, etc., all bringing their contributions for the child, from each parent. That their

offerings may be offset by some outside influence is included as a possibility. The fact that "Professor Jennings believes that new eye colors could conceivably be produced by means of chemicals," leads the author to remark that some day a girl may be able to tell at which drugstore she secured her pretty blue eyes, just as now she can tell, if she will, where she purchased her present shade of hair.

"Forecasting" the child to be born is provided for in tables which show different possible combinations of parents and the possible (or likely) results. "Forecasting" multiple births includes a full, detailed, scientific explanation of identical and fraternal twins accompanied by illuminating charts. Of course triplets and the Dionnes are discussed as well.

Under the title of "black" genes the author introduces hereditary and acquired diseases. Cancer, tuberculosis and ten other common causes of death, including diabetes, are dealt with in the light of the newest scientific knowledge, thus clearing up some questions and some doubts. Hemophilia is explained with a full-page cartoon-chart, and so is the tendency toward baldness.

What makes a dwarf? What, a giant? Why are some people color-blind? What is an albino? Should a boy and a girl search out facts about ancestors before marrying? Should insanity in the family prevent marriage? These are questions which students may not ever ask, but it is very important that they be discussed by the teacher of health. Were this continuously and universally done perhaps our institutions for sick minds might not be filled to over-flowing as they are. Among "black" genes are discussed sterility and lack of predominence of sex. "No phase of human behavior," the author declares, is more important than that of sex.

Evolution, race, and eugenics have some interesting slants presented by the author who gives a suggested "Program for Tomorrow." But before doing this he pricks the ancestral-blue-blood-bubble by presenting a table showing how meagre a chance one has of inheriting so much as a single chromosome from a Revolutionary War hero, a fact which many young folks will gleefully present to their parents who are glorying in the ancestral heritage.

"Highlights in the History of Genetics" with "Suggestions for Further Reading" comprise the appendix which precedes the index.

BEULAH FRANCE, R.N.
New York City

SWIMMING. Matt Mann and Charles C. Fries. (New York: Prentice-Hall, Inc., 1940) 102 pages, $2.00.

Swimming is written in simple and direct style. The authors have presented the fundamentals of swimming as basic to possible treatment on the techniques of the champions and the practices of the coaches essential to speed swimming. Matt Mann, coach of many outstanding winning teams at the University of Michigan, is fully qualified to speak on this subject.

The main body of the book deals with various strokes, crawl, back stroke, breast stroke, etc. Photographs taken from actual situations bring out the essential body movements of the strokes explained in the text. Following these descriptions of fundamental strokes, principles are presented for the teaching of beginners. These also are fully illustrated. Chapter VI deals with the teaching of infants, or very small children.

Although the bulk of the book is given over to swimming, there is a splendid chapter dealing with beginning diving, and another which presents provisions for water safety. The concluding chapter gives a brief review of the development of competitive swimming. Short, abbreviated admonitions appear at the end of each section summarizing in an unusual way the high points of the book.

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